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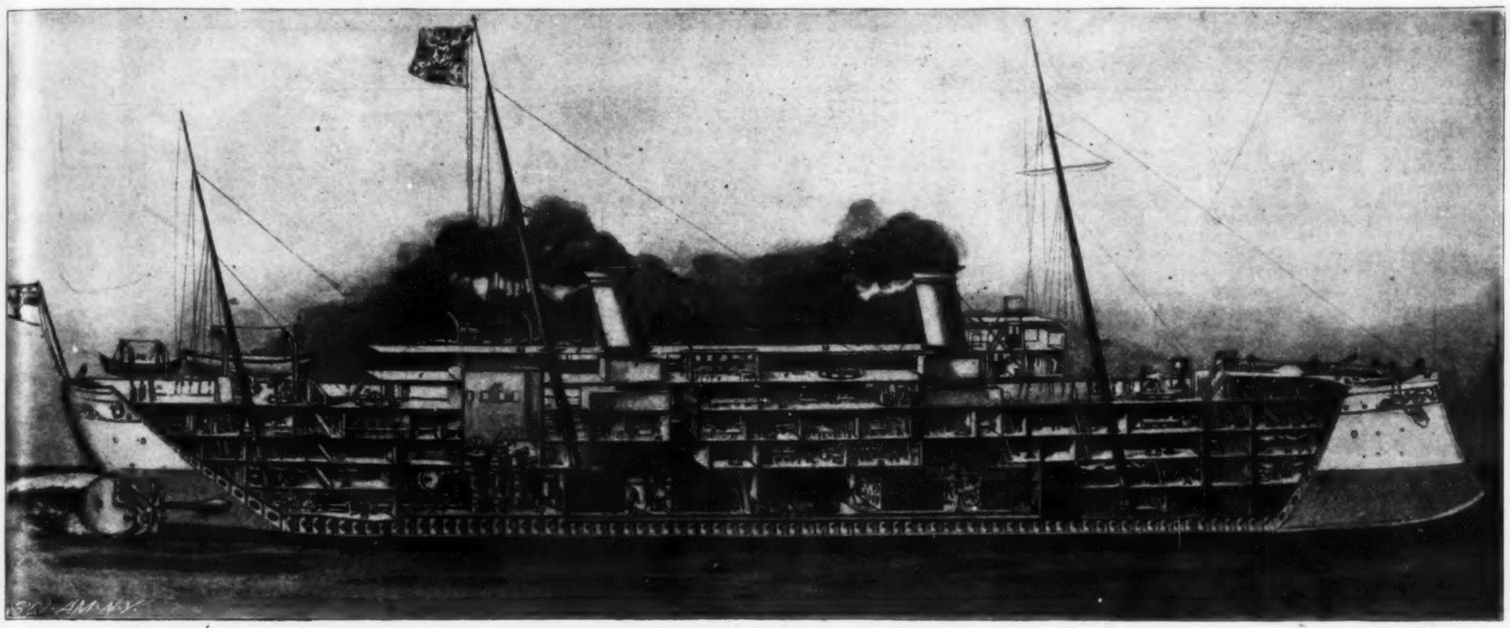
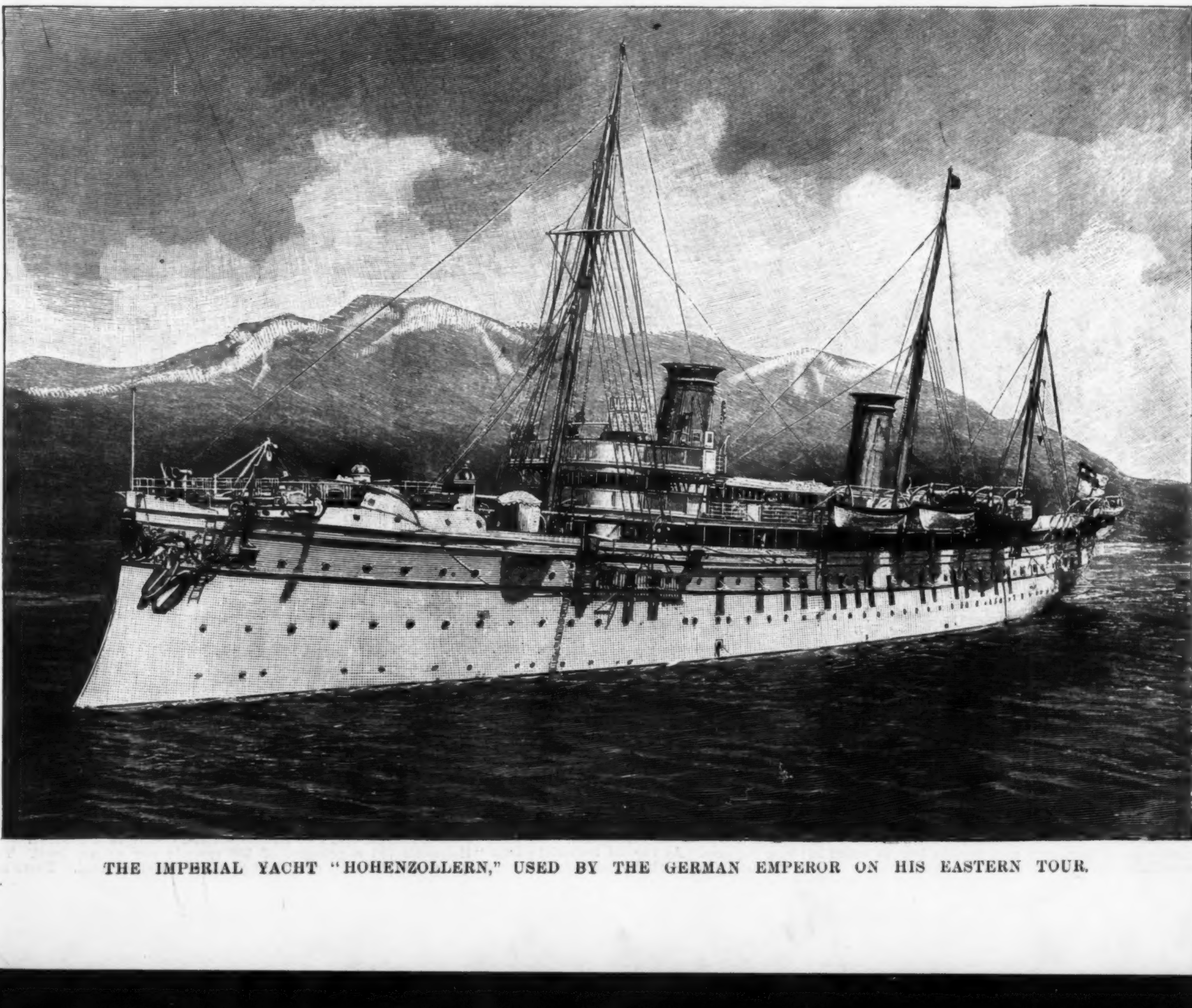
VISIT OF THE GERMAN EMPEROR TO THE HOLY LAND.

THE picture of a nineteenth century constitutional monarch leading a pacific crusade to the Holy Land is a novelty. The German Emperor has gone through a rather trying ordeal, and, while the trip has been rather theatrical and not entirely free from bathos, the Emperor has not appeared ridiculous, as even some of his friends expected that he would. The occasion has proved to be a prolific subject for the political cartoonist.

Germany would gladly have an outlet on the Mediterranean and develop her trade with the East via Constantinople or through Palestine, so William's

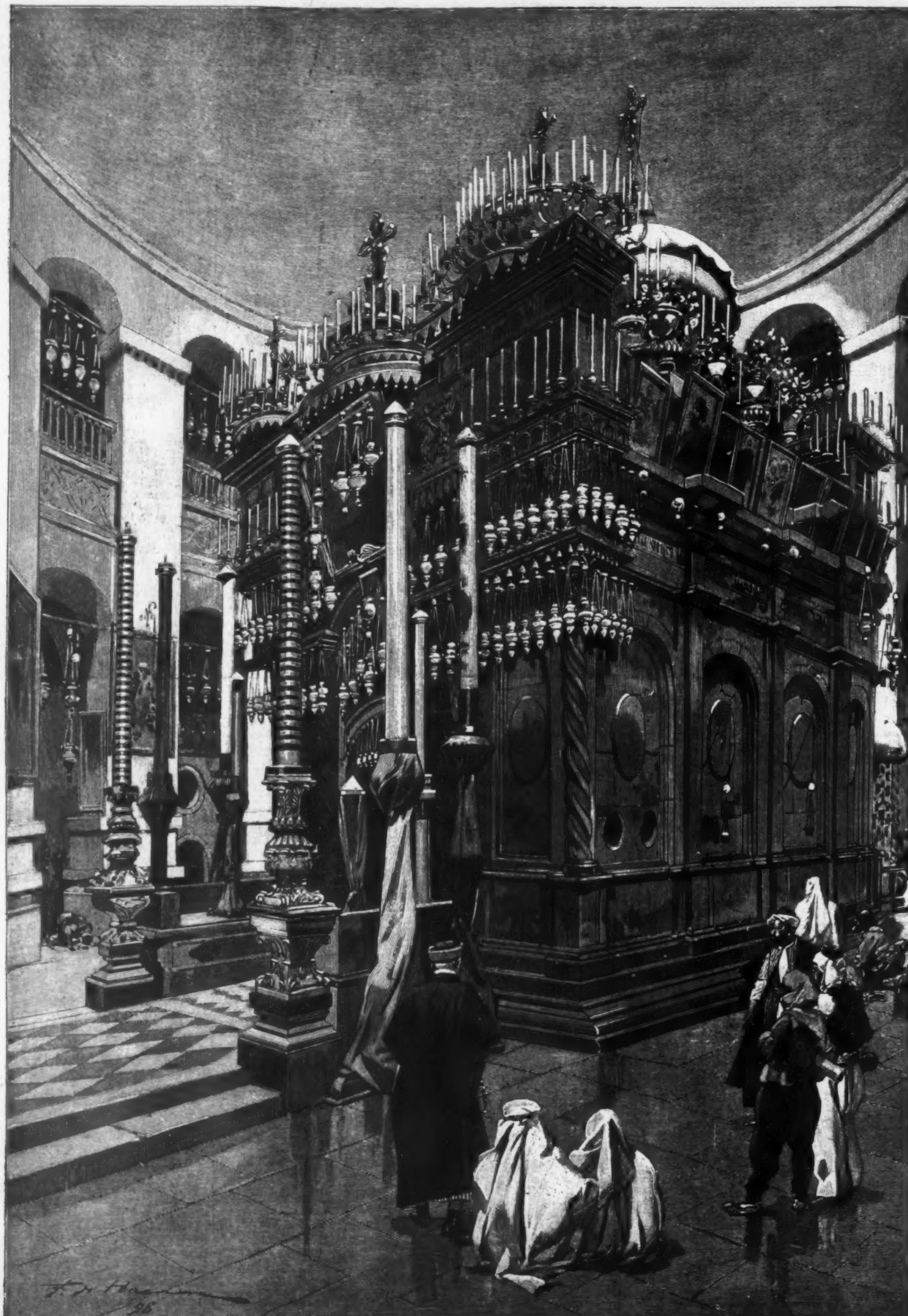


SECTIONAL SIDE VIEW OF THE "HOHENZOLLERN."



THE IMPERIAL YACHT "HOHENZOLLERN," USED BY THE GERMAN EMPEROR ON HIS EASTERN TOUR.

tour may not have been planned solely for the purpose of dedicating the church in Jerusalem. There are undoubtedly political reasons why this trip was taken. If the Emperor Francis Joseph should die, the Austro-Hungarian empire might break up and a "Greater Germany" be formed by fusion with the present empire of Germany. If this should be the case, Greater Germany would have an outlet in the Mediterranean via the Adriatic. An alliance with Turkey would imperil the position of Russia in southeastern Europe, and Germany would be in a position to fight the commercial supremacy of England in the East. A Germanized Turkey would tend to increase the prominence of Germany and enable her to assist in maintaining the equilibrium of Europe.



THE HOLY SEPULCHER AT JERUSALEM.

Palestine is a great world lying to the East by way of Constantinople, Persia, and Hong Kong. Palestine is the meeting of the roads, and whoever controls her controls the trade to the East by both land and sea, by caravan, and by the Suez Canal.

The vessel used to convey the Emperor and Empress of Germany to the East was the royal yacht "Hohenzollern." This forms the subject of our first page engravings. The German navy long needed a vessel large enough to carry the Emperor and suite in case he should take command of the fleet, to serve as an advice boat in time of war, and capable of being used by the Emperor and Empress, with their retinue, for long voyages. As the old imperial yacht "Hohenzollern" had proved wholly inadequate for those purposes, an appropriation was granted by the Reichstag and orders were given for the construction of a new advice boat that should fulfill the requirements named above. On June 27, 1892, the vessel was launched at the yards of the Vulcan Company, at Stettin, and was christened "Hohenzollern" by the Emperor, the name of the old yacht being changed. The vessel is 370 feet long, 45 feet beam, and depth 33 feet. The displacement, with an average draught of 18 feet, is about 4,200 tons. The two three-cylinder compound engines indicate 9,000 horse power, and propel the vessel at a speed of 20 knots. In each of the boiler rooms there are two single and two double boilers, twelve in all, which work at a pressure of 150 pounds per square inch. The bunkers carry a supply of 450 tons of coal. There are

two enormous smokestacks of elliptical cross section. As the vessel is not intended for fighting purposes, the armament consists of three rapid-fire guns of light caliber, two of them being placed forward on sponsons and the third is at the stern. There are also eight guns for firing salutes.

There are two decks for state rooms, etc., below the upper or main deck, and on the latter the large dining room, 52 feet long and lighted by 12 windows, and the necessary serving rooms. The roof of this saloon answers for a promenade deck, in the middle of which a little smoking room is built, while on the sides are little niche-like structures that offer comparative shelter in stormy weather. For reconnoitering the surroundings at night, two electric search lights are arranged on the forward part of the promenade deck, and above these rises the commander's bridge, on which a little house has been erected to be used as a lookout. Three steel masts serve for signaling and sailing purposes.

The eight small boats hanging in davits along the sides of the vessel can be used for communication with the shore or for life-saving purposes.

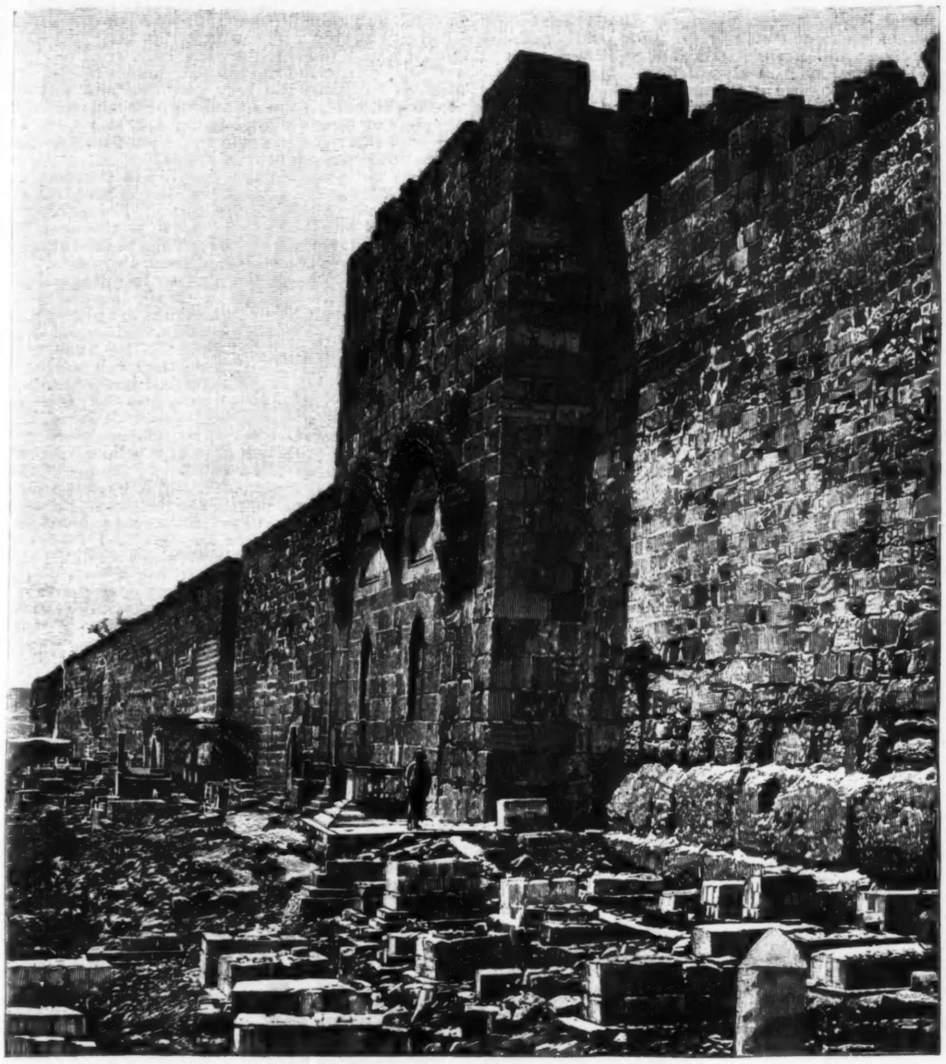
The most important rooms are on the first middle deck, just below the upper deck. Starting from the stern, we come first to the offices and the secretary's room, and these are followed by rooms for those in charge of the Empress' wardrobe, the stewardesses, and by the pantries and bath rooms. Farther forward are state rooms and bath rooms for the suite, and the ladies' saloon, while about in the center of the vessel are the apartments of the Emperor and Empress, arranged on opposite sides of a passageway and consisting of sleeping, dressing, and bath rooms, besides the Emperor's work and audience rooms and the Empress' sitting room. Next to these is the general saloon, and forward of that the rooms of the young princes. On the forward part of this deck are rooms for some of the officers and crew, and beyond the princes' rooms are the mess room and living room of the commander and officers. After these are some rooms for the crew, while the hospital and apothecary's shop occupy the foremost part of the vessel.

On the second middle deck are rooms for the servants, for the Emperor's wardrobe, baggage rooms, the imperial galley, etc., as well as saloons for the deck officers and crew, and the necessary bath rooms, laundries, drying rooms, and the officers' cuddy.

On the platform deck, under the first middle deck, are the baggage rooms for the imperial suite and the servants, and also the wine room. A steam heater and three dynamos are located on this deck, for supplying heat and light for all the rooms, and besides these there is a secondary battery to be used in case the dynamos should cease to work during the night on account of the stopping of the engines. Two distilling apparatus, also on this deck, supply fresh drinking water, and there is a refrigerator for the preservation of meat and other food. In the hold are the engines and boilers, and also the rooms for storing food and water for the crew.

Besides the large engines for propelling the vessel, there are 30 auxiliary machines. The crew is to consist of 260 men.

The Reichstag granted an appropriation of $1,890.-756 for the construction of the "Hohenzollern."



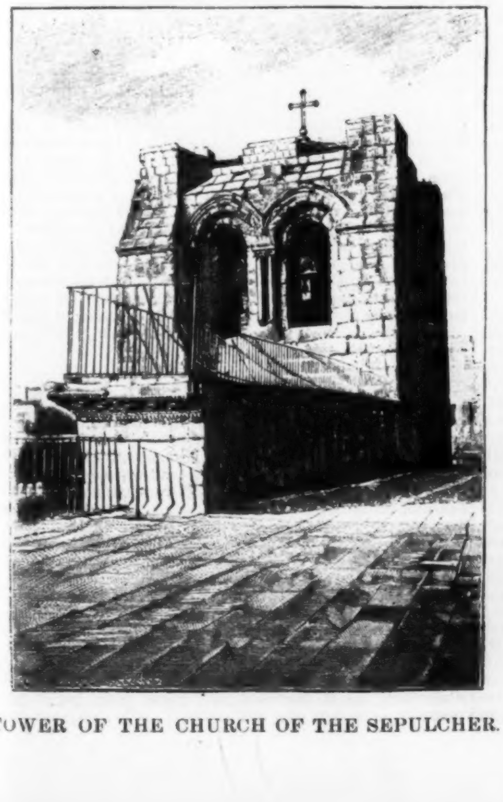
THE GOLDEN GATE OF JERUSALEM.

Palestine is a small country, ascetic and primitive in aspect, but to the greater part of the civilized world it is a most interesting spot, as in it center all the important events in the life of the founder of the Christian faith. The landscape is of the same stony hue as the houses and the miserable villages. Moslems, Christians, and Jews live cheek by jowl.

Jerusalem is, of course, the center of attraction, not only to those of the Christian faith, but to the Moslems as well, for the latter come from the farthest East to pray on the holy rock whence the Prophet ascended into heaven. The dome of the rock is covered by a beautiful building, which in a view from the Mount of Olives appears to crown the city. It occupies the site of Solomon's Temple.

Of late years Jerusalem has grown rapidly outside its walls toward the west. Fine structures have been raised, churches, schools, and hospitals, and big hotels to shelter the tourists have been built. Here is also the terminus of the new railway from Jaffa. The railway may shock the sentiments, but it certainly comforts the body of the pilgrim. The ordinary traveler is apt to be perplexed as to the exact spots of historic interest pointed out to him by ignorant guides, and many of the chapels, shrines, and monasteries are built on supposed sacred places many centuries after the site has been forgotten. In spite of the large demands upon the credulity of the traveler, most of the important and anciently revered places have been verified to the satisfaction of the learned quite as completely as places of historic interest in any other part of the world. It is a curious coincidence that two Englishmen occupying a large amount of the world's thoughts at the present moment gave much study to the topography of the Holy Land. General Gordon for a short time lived almost the life of a recluse in a monastery at Ain Karin and Lord Kitchener surveyed part of the country for the Palestine Exploration Fund. Gordon's notes and diagrams were full of fresh ideas. The Church of the Holy Sepulcher is a venerable looking old place, and if for no other reason would be of great interest, as it was the goal and object of all the crusaders during the middle ages. The whole building with its numerous chapels and shrines is a perfect museum of tradition.

William I. of Germany received from the Sultan a piece of ground at Jerusalem on which stood the ruins of the old Church of the Saviour. This land was taken possession of by the then Crown Prince Frederick on November 7, 1869. In 1871, the architect Adler was authorized to survey the land, to draw up plans for the restoration of the church and the buildings belonging to it. Difficulties of all kinds prevented him from carrying out this plan, but in 1892 the present Emperor authorized the erection of the present church, modifying the original plans somewhat. In 1893 the government builder was ordered to Jerusalem, and on October 21 of that year the cornerstone was laid.



TOWER OF THE CHURCH OF THE SEPULCHER.

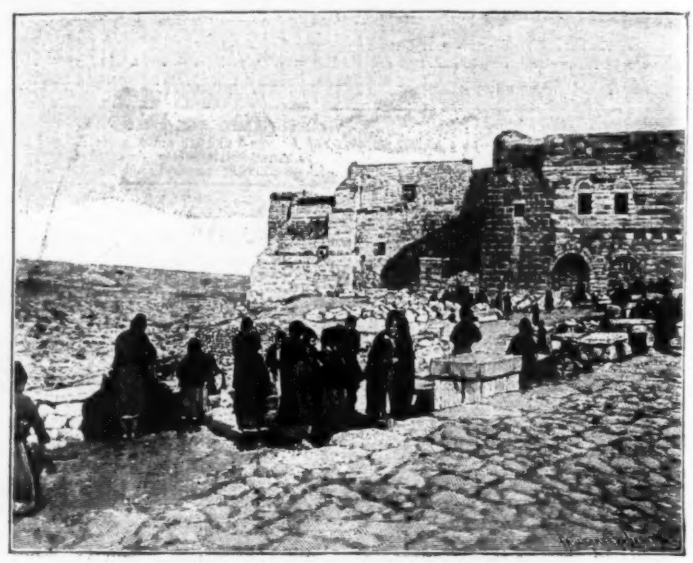
INTERIOR OF A HOUSE IN JERUSALEM.

JAFFA GATE OF JERUSALEM.

The church is located in a direction south of the Church of the Holy Sepulcher. The entire ground about the church belongs to the Knights of St. John, who as early as 1048 had obtained a footing in Jerusalem. The Grand Master Raymond du Puy (1118–59) here erected magnificent structures, among which was the present church, which was built in 1129–30. It was called St. Maria Latina Major. After Saladin conquered Jerusalem in 1187, the church was no longer used as a place of Christian worship, part of it being used as an insane asylum. When the Germans cleared away the ruins, they found little left of the old structure. Nevertheless, an approximately accurate idea of the church could still be formed from what remained. It was determined that the original church was probably of medium size. It was triple naved, cross-formed basilica, with three semicircular apses, octagonal dome and square belfry. The windows and the northern portal were round-arched. In the interior the pointed arch had been used. Flat buttresses strengthened the walls. The roof was composed of flat stones. It soon became apparent that the old foundations could not be used, for the old Maltese builders had erected the church with almost incredible carelessness upon the remains of an early quarry. In restoring the church, very dense and durable limestones were used, which for centuries had constituted the principal building stones of monumental structures of the Holy Land. The altar, the pulpit and the baptismal font have been restored with the limestone, partly white and partly colored. The plans for the belfry, which is 54½ meters in height, were drawn by the Kaiser himself, and the restorations were carried out with the Kaiser's assistance.

The principal object of Emperor William's visit to Jerusalem, the consecration of the Church of the Redeemer, was accomplished on October 31 with impressive ceremonies. His Majesty, wearing the white mantle of the Teutonic Knights, rode on horseback to the church, escorted by a brilliant cavalcade of knights similarly attired. The Empress and her suite rode in state carriages. At the conclusion of the elaborate and solemn service the Emperor advanced alone through the chancel and up the steps of the altar, where he knelt for a few moments in silent devotion. Then, turning, he read a written allocution, in the course of which he said: "From Jerusalem there came the light in the splendor of which the German nation became great and glorious. What the Germanic peoples have become they became under the banner of the cross, the emblem of self-sacrificing Christian charity. As nearly 2,000 years ago, so there shall to-day ring out from Jerusalem the cry voicing the ardent hope of all for 'peace on earth.'"

A STREET IN BETHLEHEM.



OUTSIDE THE WALLS OF BETHLEHEM.

The Emperor has curtailed his tour to the Holy Land and abandoned his visit to Jericho, Jordan, and the Dead Sea. It is announced that the shortening of his programme was owing to the excessive heat, from which forty horses belonging to the imperial party had died, but it is believed that his action was due to international complications in Europe. Among the interesting things which the Emperor saw at Jerusalem was David's tomb on Mount Zion, to which the Emperor was admitted by the Sultan's express order. It has never been seen by a Christian since 1187, it being a Mohammedan shrine of the most sacred order. The iman who conducted his Majesty to the tomb mentioned this fact to him, and added that to the German Emperor, the Sultan's friend, all Mohammedan institutions were open. It is thought that the historical importance of the interesting and memorable ceremonial of the dedication of the Church of the Redeemer will before long be apparent.

For our illustrations we are indebted to Illustrirte Zeitung, L'Illustration, and Black and White.

BOOKWORMS.*

The naturalist frequently spends a good deal of time in abuse of his fellow man, considered in the light of a destructive agent; he points ruefully to the reduced faunas and floras of certain islands, to the dodo, to the moa, and to various creatures which have been extirpated by the direct or indirect influence of human occupation of the countries where they once flourished. But there is no action without compensation; and while man has sensibly impoverished the fauna and flora of the world in which he lives in some directions, he has unwillingly encouraged and promoted the welfare of many creatures belonging to humbler groups than those which he has thinned or entirely abolished. The average householder, as he takes his nightly rounds with a view to bolts and bars, is probably not aware that with luck and under favorable circumstances he might meet with nearly one hundred species of insects and other allied forms to whom he has not only furnished secure lodgings, but abundant food. Several species of clothes moth batten upon his Sunday coat; two species of cockroach may or do stalk boldly through his kitchen; and, in short, a host of creatures—some of them importations from abroad, destitute aliens in fact, thrive at the expense of the most formidable enemy of the brute creation. Our libraries afford pasturage to quite a number of small creatures, for the most part beetles, which have found in the dry leather and paper (and doubtless, too, on account of the infrequency with which books are apt to be consulted) a more suitable home than the woods which they presumably at one time inhabited. The Rev. J. F. X. O'Connor, whose interesting little book about bookworms is before us, was led to investigate these destructive creatures by discovering one in an old folio belonging to the library of Georgetown College.

Being a lover of books, it is not surprising to find that the author's interest in his discovery was tempered by a reflection upon the enormous damage which the ancestors of his capture had inflicted in their time. He proceeds to remark—perhaps with more truth than freshness—that "books are precious things, for in them lies stored the wisdom of the centuries." But, although a man of letters rather than a man of science, Father O'Connor divides his booklet fairly—even rigidly—into two parts: one of these is devoted to the literary history of the bookworm, the other to its natural history and depredations. It is upon the latter half that we shall have most to say here.

The expression "the bookworm" is often used; but it is inaccurate, for some seven or eight species, perhaps more, actually do commit depredations in books. Besides, these creatures are not restricted in their diet to books. Dry food of no kind comes amiss, and one of the species which the author refers to, Dermestes lardarius, has received its specific name on account of the fact that it delights chiefly in bacon. Anobium paniceum, another beetle, is fond of books; but it feeds upon almost anything that comes in its way; the most singular food recorded as having been sought out by this exceedingly omnivorous insect is cayenne pepper.

Several other beetles and their larvæ fairly come under the designation of bookworms; and, indeed, it is only in this class of insects that we meet with species capable of producing those elaborately curved tunnels which often disfigure old books, and of which one or two samples are figured by Mr. O'Connor. When uninterrupted in their ravages, some of these beetles are able to progress through the interior of books for quite a long distance, eating their way before them like an earthworm boring through the soil. Messrs. Kirby and Spence, and also Mr. O'Connor, quote an instance of a bookworm which traveled through no less than twenty-seven folio volumes in so straight a tunnel that, by passing a string through the perfectly round hole that it had made, the entire set of volumes could be lifted at once.

To the popular mind the term "worm" implies anything of a smallish kind that scuttles, wriggles, or crawls; and with this notion is blended an idea of voracity and omnivorousness. We may fairly therefore put down, as does Mr. O'Connor, the "silver fish" among the category of bookworms. This creature, Lepisma saccharina, is, of course, not a beetle, but a representative of that archaic group of insects the Thysanura; it is quaintly described by Hooke in his "Micrographia" as "a small white silver-shining worm or moth which I found much conversant among books and papers, and is supposed to be that which corrodes and eats holes through the leaves and covers. It appears to the naked eye a small glittering pearl-colored moth, which, upon the removing of books and papers in the summer, is often observed very nimbly to scud, and pack away to some lurking cranny, where it may the better protect itself from any appearing dangers." Unlike the black-headed bookworm, Ptinus fur (which it has been suggested acquires its black head from its partiality to black letter books), the Lepisma lets printed matter severely alone, and carefully eats round it. The object of the Lepisma seems to be rather the paste than the paper or the binding. But it is not select in the matter of diet; and, among other foods, shares with the clothes moth a taste for garments and carpets. It has furnished Hooke with some physiological reflections which we quote from Mr. Butler's "Our Household Insects." "When I consider," observes the author of the "Micrographia," "what a heap of sawdust or chips this little creature (which is one of the teeth of time) conveys into its intrals, I cannot chuse but remember and admire the excellent contrivance of Nature in placing in animals such a fire as is continually nourished and supply'd by the materials convey'd into the stomach, and fomented by the bellows of the lungs; and in so contriving the most admirable fabrick of animals as to make the very spending and wasting of that fire to be instrumental to the procuring and collecting more materials to augment and cherish itself, which indeed seems to be the principal end of all the contrivances observable in bruit animals."

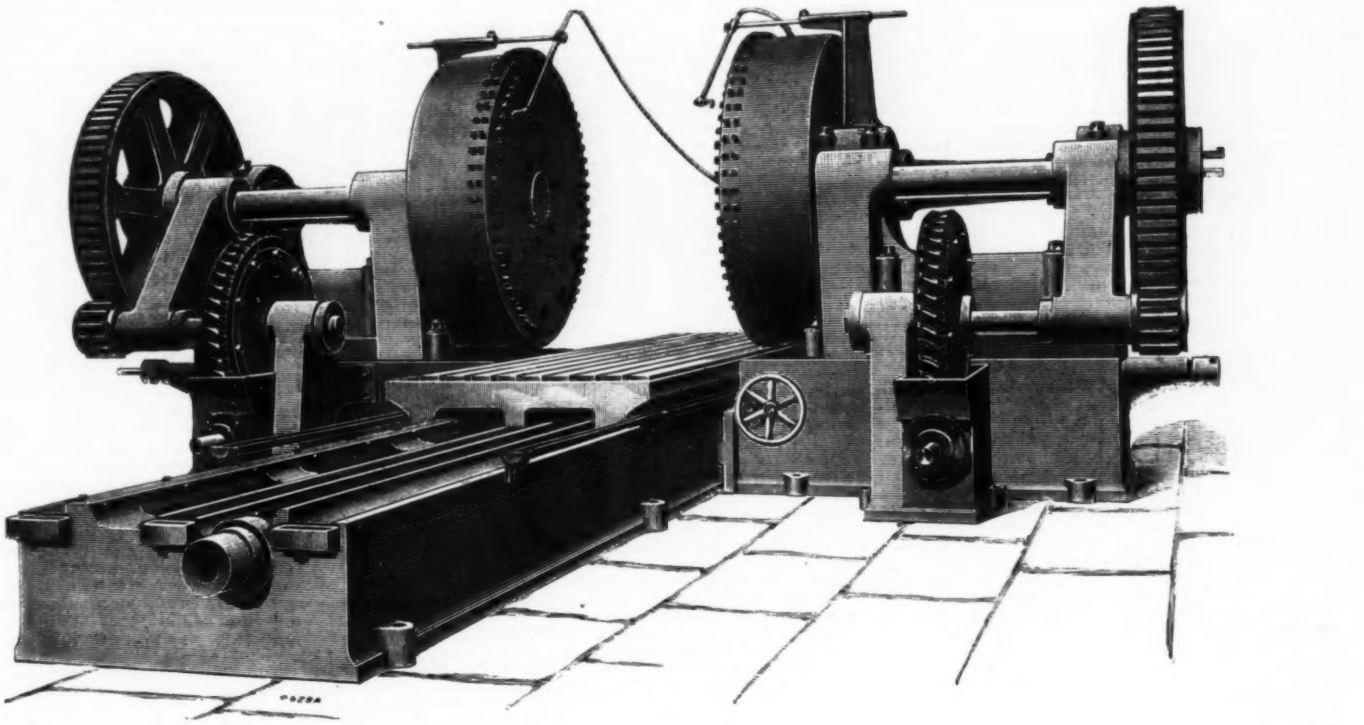
A less obtrusive though hardly less tiresome foe to the book lover is an insect which has been called the "book louse" (Atropos divinatoria). The term "louse," however, is unnecessarily offensive to the insect, for it is not parasitic and does not belong to the same group as that which contains the obscene Pediculus. It is a Neuropteron, allied, therefore, to the dragonflies. It may be reasonably placed under the heading of bookworms—although Mr. O'Connor has not placed it there—owing to its partiality for paste. The specific name of the insect is connected with the fact that it shares with the death watch (a beetle) the habit of producing an ominous ticking sound, carrying terror to the heart of the superstitious. It appears, however, that this is merely an amorous conversation with, or an act of adoration directed toward, the female insect, who is fascinated and overcome by this continued expression of feeling. This sound is caused by the insect knocking its head upon the ground, and it has been wondered, by those who underestimate the power of love, how so small and tender an insect can create so loud a sound. Nevertheless, it seems to be the fact that it does. The author, after dealing shortly with various kinds of book worms (which are illustrated by not always very good figures), proceeds to the practical consideration of how to get rid of them. He is of opinion that (to speak somewhat hibernically) it is better to stop the mischief before it has commenced. Paste containing such a deadly element as corrosive sublimate is recommended for binding purposes; elsewhere we have seen the suggestion that pepper is a useful article to mingle with the paste. But this would be obviously a substance of no use wherewith to confront that particular kind of bookworm which relishes a diet of cayenne. The general panacea for insects of all kinds is camphor. But here again the bookworm is not to be so easily combated. Specimens of one kind have been found comfortably and confidingly nestling beneath pieces of camphor which it was hoped would put a speedy end to them. Possibly the best cure would be to put the books themselves to their legitimate uses, i. e., to read them. This would necessitate a constant shaking which would prevent the pest from obtaining a secure lodgment. But considering that the Royal Society of Science, of Göttingen, in the year 1744, and the Society of Bibliophiles of Mons, in the year 1842, offered in vain a prize for the solution of these difficulties, it is not surprising to find that on the whole the bookworm has triumphed over both the bibliophile and the naturalist. In any case it has done us this service: it has furnished the material for a most interesting little book by Father O'Connor.

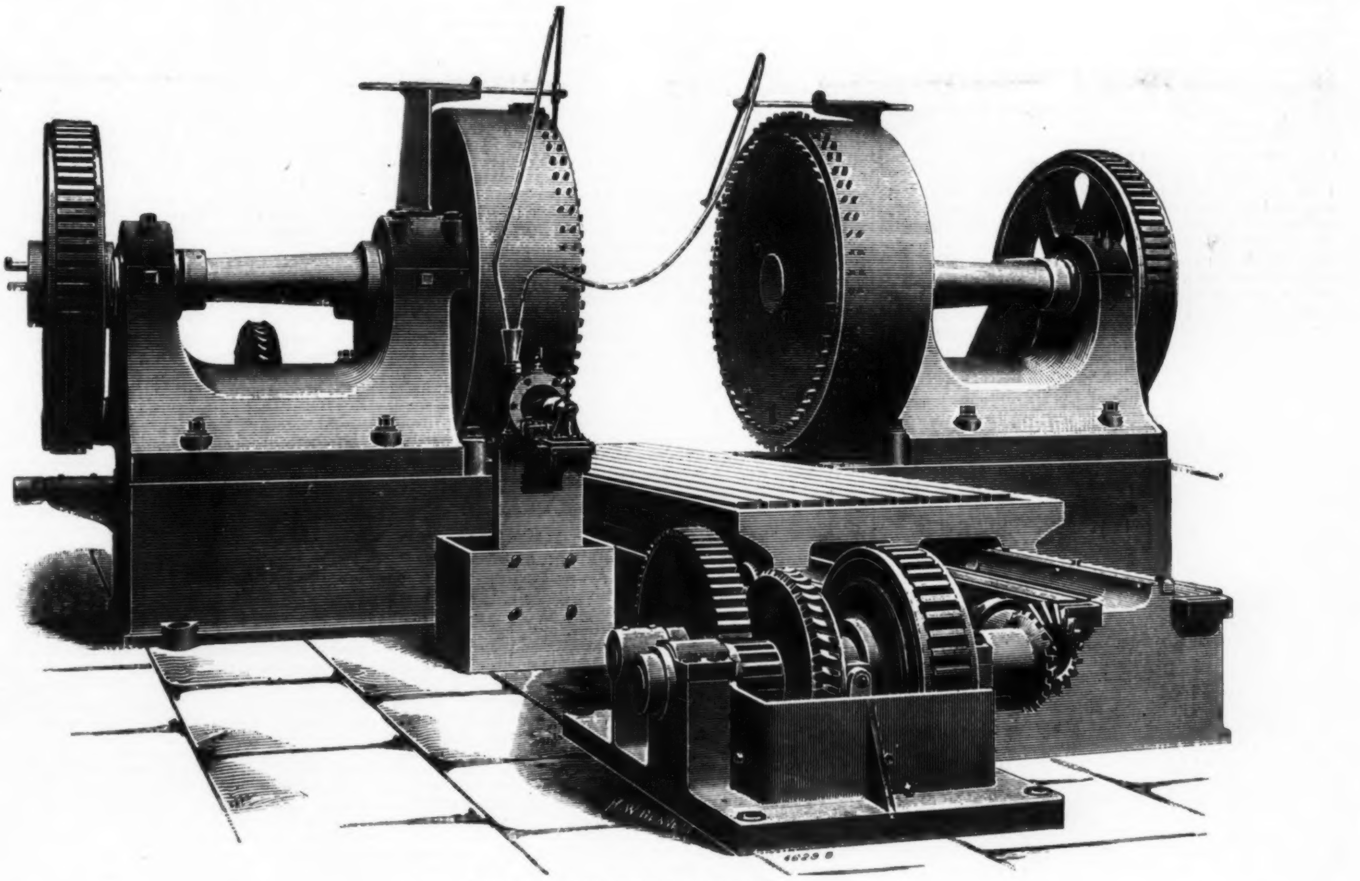
* "Facts about Bookworms." By Rev. J. F. X. O'Connor, S.J. (London: Suckling & Company, 1898.)—From Nature.

The fact is noted in a technical journal of the already considerable as well as rapidly increasing quantity of cotton fiber that is annually consumed in the manufacture of absorbent cotton for surgical uses. The process of preparing the raw cotton for such purposes is given as follows: After boiling in a solution of potash, which eliminates all the greasy and waxy matter, the residue cotton is placed in a so-called "whizzer" and dried. Being then treated to the medicating process by the use of such antiseptics as diluted corrosive sublimate and carbolic acid, the cotton is placed upon cards and run into laps, being thus made ready for the market, where it brings a comparatively high price. Prepared according to this method, the cotton is in admirable condition for the staunching and covering of wounds, and in the sick room is regarded as equally valuable in its simple and effective action, absorbing, as it does, all moistures with great readiness.

LARGE SLAB DUPLEX MILLING MACHINE.

THE machine which we illustrate herewith is one recently made by Messrs. Shepherd, Hill & Company, Limited, machine tool makers, of Leeds, for Messrs. Siemens Brothers & Company, Limited, Woolwich. It is arranged to operate upon two surfaces at once, and these surfaces may be as much as 15 feet long and 40 inches deep, the maximum depth of cut being ½ inch when working on steel. The machine consists of a strong cross-box bed 30 feet long and 4 feet wide, and of deep section, for the table carrying the work to slide on. This table is 17 feet long and 4 feet wide, and of deep section, having three broad flat surfaces on which it slides, and is, of course, very rigid to avoid springing by the downward pressure of the cutting tools. It is traversed along the bed, when the tools are cutting, at the rate of 2 inches per minute, by means of a large steel screw inside the bed. This screw is driven at the end by a suitable clutch reversing gear, and gives a quick return. An electric motor of 5 brake horse power is employed to drive it. Two massive box foundation beds are lipped into and firmly secured to the center of the long 30 foot bed, standing out at right angles to it on both sides, whereon are fixed two powerfully geared headstocks carrying the large cutter plates. These headstocks are adjustable endwise to suit work from 2 feet to 4 feet wide. Each cutter plate is 5 feet 3 inches in diameter, and carries 60 roughing and 3 finishing tools, traveling at the rate of 17 feet per minute. The headstocks are driven separately, each by a 40 brake horse power electric motor. The necessary reduction of speed is effected by steel worms driving phosphor bronze wormwheels of large diameter, a further reduction being effected through internal and external powerful steel gears, so arranged that the power is applied as close to the cutting tools as possible, thus avoiding all unnecessary torsion, and consequent liability to jar. The spindles are of steel 12 inches in diameter, and merely carry the cutterheads or plates and internal driving wheels, no drive passing through them. The tools are lubricated by a centrifugal pump, an oil tank, and appropriate connections, insuring a constant flow of lubricant on the cutting surfaces. This machine will mill two surfaces each 10 feet by 40 inches per hour, a total surface of 66 square feet. We are indebted to London Engineering for the cuts and description.





DUPLEX MILLING MACHINE.

Some time since the interior of Pardee Hall, Lafayette College, was destroyed by fire, and after the standing walls, which are of stone, had been pronounced safe for rebuilding, the sand blast was employed for removing the smoke stains and crumbled surface. The compressor was one of the Ingersoll-Sergeant direct acting type, having a 10 by 10-inch steam cylinder and a 10 by 14½ air cylinder. From the air receiver the air was carried by a pipe to the third floor of the building and from thence by a hose to the portable sand blast apparatus. The velocity given to the sand was high, and it cut away the discolored surface in a very rapid and satisfactory manner.

PROGRESS IN ELECTRO-METALLURGY IN 1897.*

THE difficulties which surround the electro-metallurgy of lead are so great that they have almost discouraged attempts to overcome them. It is improbable that there will be any electro-metallurgical method for the deposition of lead more scientifically and practically studied and developed than the system of Dr. Tommasi, an electro-chemist whose books are indispensable to those who go in for electrolytical research work. His process for desilverizing lead consists in depositing lead on rotating disks from a solution of acetate and other compounds of lead. There is no formation of peroxide of lead at the positive pole. The lead goes to the cathode and the silver falls into a receptacle at the bottom of the tanks into which it is collected. There is no polarization in the electrolyzers; the resistance is very low; the lead only is dissolved and deposited and the silver is untouched.

An estimate shows that, with a current of 1,800 amperes and 375 volts, 84·24 kilos of lead can be deposited every twenty-four hours at a cost of less than $2 per ton. A characteristic feature of this process is that it can be advantageously applied to the treatment of poor lead ores. Dr. Tommasi has also devised a process for making lead oxide or carbonate, which is carried out at his model works in Paris.

In his presidential address to the Institution of Elec-

* Written for the Engineering and Mining Journal by E. Andreoli.

'trical Engineers on the process of electro-chemistry, Mr. J. W. Swan dwelt at length on the refining of copper by the electric current, but beyond mentioning the production at the Anaconda works, he said nothing about the immense development of electrolytic copper refining in the United States, which is without a parallel in the world. Mr. Swan retold the story of his process for electrotyping with a large current density, for getting tough copper with 1,000 amperes per square foot of cathode surface and making use of a concentrated solution and an extremely rapid circulation of the electrolyte. Mr. Swan was neither the first nor the only one to make use of a very strong current for electrotyping. He spoke of the "many attempts made to utilize the fact that copper matte or sulphide can be cast in the form of plates or slabs and that such plates have a sufficient degree of conductivity to allow of their being used as anodes in an electrolytic bath. These attempts have not always been successful, but there is an interesting exception in the case of the copper-nickel mattes worked by the Canadian Copper Company, which refines copper and nickel electrolytically, and uses the matte as anodes. The mattes contain about 40 per cent. each of copper and nickel, and 14 per cent. of sulphur, together with small quantities of silver, gold, and platinum. The power used in the production of 1 pound of nickel is nearly 1 electrical horse power per hour."

We shall only mention the experiments made by Professor Foerster, who obtained a bright deposit from a concentrated solution of nickel chloride or sulphate at a high temperature, using carbon anodes, with a current of 8 amperes per square foot. Carbon never makes a good anode in a solution of chloride or sulphate. This cannot be called an improvement on the actual electro-deposition which has already been, for many years, well known and is a well established industry.

There is little new to be said about the electrolytic production of chlorine and caustic soda. The Castner-Kellner Alkali Company, Limited, has pushed forward the erection of large works in England and the United States. The Parent Electrolytic Company, which owns the new Hargreaves-Bird process, has sold its French patents to the Société de St. Gobain, and is on the eve of starting in Lancashire an important installation for the manufacture of bleaching powder and chlorates.

A great deal has been said about the Rhodin process, but hardly any criticisms have been published in the technical press on this process, which is the property of the Commercial Development Company. We must wait for the results obtained from the working on something like a commercial scale of the process.

In the Rhodin process it is proposed to work at nearly 100° C. The mercury in this case not only diffuses in the hydrogen, but also into the water vapor which is carried off by diffusion in the hydrogen itself. Under such conditions a loss of from 7 to 8 pounds of mercury for each ton of salt decomposed may be reckoned as a minimum.

Three or four years ago the opinion sprung up that there was a brilliant future before the chlorine and alkali industry in the electrolysis of fused chloride of sodium. The success of some experiments made on a relatively large scale led some electricians to believe that the problem of the production of chlorine was solved. Mr. Vautin, however, did not persevere in this work, and abandoned his process, which consisted mainly in the use of a cathode made of lead. Leon Hulin, a French chemist, has used molten lead as a cathode since 1891, and he now uses chloride of lead. His process is known and we shall not describe it here. The Société des Soudières Electrolytiques employs Hulin's process in France at Clavaux, near Grenoble, and up to the present there is every hope that the dry method will eventually become a success.

The formation of an alloy, by means of a metallic electrode in a fused electrolyte, has been known for many years, and the history of the aluminum industry has shown us how bronzes were made by the electrolytic process. Diehl, for instance, employed a lead cathode in an electrolytic crucible which allowed him to obtain at the bottom of his crucible alloys containing up to 75 per cent. aluminum. With regard to the electrolysis of chloride of sodium, the case is rather different. It was an American electro-chemist who first had the idea of using a lead cathode. Prof. A. Rogers, whose process for producing chlorine and sodium is described in many books and papers on electrolysis and electro-metallurgy, and who has devoted a great amount of time to the electrolysis of fused salts and to the production of alloys by means of electrolysis, gave a lecture in 1889, in which he described how sodium and lead alloys, or sodium and tin alloys, could be produced in an electrolytic tank. Particulars of this process, which was described in the "Proceedings" of the Wisconsin Natural History Society (April, 1889), are highly interesting for the commercial application of the electrolysis of fused chloride of sodium or potassium, with a view to the production of chloride and pure caustic soda or potash.

The new electrolytic methods for extracting gold from its ores or treating gold solutions seem generally to be little adapted to the treatment of large masses of ore. Among those electrolytic processes there is not a single one that can be applied economically to the treatment of from 100 to 200 tons of ore a day.

There is a Cassel electrolytic process for the extraction of gold by electrolysis, which we simply mention. The Cassel process is electrolytic; the Hinman-Cassel process is not electrolytic. In this process the roasted ore is leached in open tanks with a solution made by adding bromine to caustic soda. Previous to leaching the ore is rendered slightly acid, and when the bromine lye comes in contact with the acid, bromine is set free and dissolves the gold. The bromine liquor is then run off and the ore washed. The liquor and washings enter a tank without coming in contact with the air; any combined bromine is liberated by the addition of a mixture of bromate, sodium chloride and an acid, and the bromine is removed by a current of air which is blown through the heated liquid. This air current is led through a tower down which a stream of caustic soda solution trickles, by which the bromine is completely absorbed and the solution is brought to its initial condition and serves for a second extraction. The blown liquor is mixed with a solution of sulphide of sodium; the gold is thrown down as sulphide and is easily recovered by roasting and fusing. For shipment, the bromine is in an innocuous state. The inventors make a dry salt consisting of bromate, bromide, and a suitable chloride. Messrs. Hinman and Cassel say that, by their process, telluride ores can be treated with success, and a high extraction of the gold is obtained at low cost. The process can be carried out with a minimum amount of water (even when highly charged with salt), as the solutions employed are used over and over again, the only waste being confined to that which remains as moisture in the tailings. They do not require to pulverize the ores to such a degree of fineness as is essential for the weaker solvent, cyanide of potassium.

According to Mr. Cassel, many attempts have hitherto been made to use bromine for metallurgical purposes, but none were successful, for the reason its use involved its total loss, so that former experimenters were restricted to the employment of insufficient quantities in order to obtain a perfect extraction of the gold. Their system involves the recovery of the bromine employed, with a loss of about ½ pound of bromine to the ton of ore treated.

Very little is known about the chlorocyanide process for the extraction and recovery of gold, and no information can be obtained. Chlorocyanide is made by fusing ferrocyanide of potassium and chloride of sodium; this is a slight modification of the old Ellershausen process, which consists in fusing ferrocyanide to obtain pure cyanide. The only results which the Chlorocyanide Manufacturing and Gold Extraction Company has published refer to the electro-deposition of gold on cycles to impart a better finish and more attractive appearance to the machines.

The Haycraft process of gold reduction is represented as simple and complete, the whole of the ores being treated in one operation after coming from the mill, and all the gold being practically extracted during that operation in two hours time. The ore is reduced to the fineness of a 60 × 60 mesh; it is then transferred to steam jacketed pans, each capable of holding one ton of ore, and fitted with stirrers; 20 pounds of common salt, 100 gallons of water, and 100 pounds of mercury complete the charge, which is heated to a boiling point and the mercury is spread throughout the pan by the action of the stirrers. Electric currents are applied to the pans, causing the solution of the gold and the formation of an amalgam. The charge is then run out, any waste of mercury being obviated by means of a concentrating table, and the residue flows into settling tanks. There are several points of resemblance between this process and the arrangement which characterizes the Pelatan-Clerici system. This process has been described in several papers, but, with one exception, it has never been criticised.

The Keith process is worked by the Keith Patents Syndicate, Limited. A great fault in this is that porous pots are the basis of the electrodeposition of gold, and porous pots are prohibitory in electrolytic tanks intended for the gold-fields.

Mr. Cowper Coles has been remarkably successful in the electrodeposition of zinc on a commercial scale, and his process has been adopted by several English firms, who work it on a royalty. He also deserves to be praised for his parabolic mirror, which he makes by first of all silvering glass which has the curvature of the mirror required, then depositing copper on the silver, which is finally coated with a deposit of palladium. The metallic film is detached from the glass by simply heating, when, owing to the different rates of expansion of the metal and the glass, they become very easily separated. In his gold recovery process he uses iron anodes and aluminum cathodes in a weak solution of potassium cyanide. The advantages he claims are that the gold is recovered as pure gold, not as base bullion; the consumption of potassium cyanide is much less than in any other process; the cost of labor is considerably reduced, as the anodes and cathodes only required renewing at long intervals. The actual weight of gold recovered can be determined daily; the cyanide solution can be used for a longer period, as it is not contaminated with any base metals, such as zinc. There is no consumption of zinc or lead, as in the MacArthur-Forrest and Siemens-Halske processes; no smelting furnaces are necessary; no zinc shavings required.

Mr. Cowper Cowles uses iron plates at the positive pole, and it is therefore rather difficult to conceive how and why his gold-potassium cyanide solution would not become contaminated. Taking for granted that the deposition of gold on an aluminum cathode proceeds in a uniform manner, but in such a way that the gold is deposited as a metallic sheet which is easily detachable from the aluminum plate by stripping or peeling or rubbing, this is the worst thing which can happen in a gold extraction installation. We are not quite sure that a thick deposit can be obtained on aluminum, and that the gold does not fall to the bottom of the tank; but we are certain that no gold mining company will adopt cathodes from which gold can be stripped off by simply rubbing. It would be too much of an encouragement to gold thieving.

Mr. Cowper Coles speaks of a solution containing only 0·01 per cent. and 0·0075 per cent. potassium cyanide and 2½ dwts. of gold to the ton, which is heated to a temperature of about 100° F., and of a current density of 0·03 ampere per square foot of cathode, the E. M. F. being 6 volts. He does not, therefore, seem to be aware of the actual condition of the electrolytic work in the Transvaal.

The writer has heretofore described the anodes made of peroxide of lead which he invented, and of which the patents for the Transvaal, the United States, Canada, and Mexico have been sold to Mr. Charles Butters. The iron anodes used in the Siemens-Halske process become dissolved and contaminate the electrolyte, owing to the formation of oxide of iron and Prussian blue. The peroxide of lead anodes being insoluble in a solution of potassium cyanide, the solution is always clear. The gold is deposited on iron cathodes, which, when sufficiently coated with it, are dipped in molten lead, which immediately absorbs the gold, and a few minutes after the iron cathodes, bright and clean, can be put back in the tanks to become again coated with gold, and so on.

The Transvaal is at present the only country in the world where electrolysis is applied to the precipitation of gold, but in 1898 electrolyic installations will be started by Mr. Ch. Butters and some electro-metallurgists from his Johannesburg staff, in the United States and in Mexico.

The superiority of the electrolytic over the zinc method is now recognized in the treatment of the liquor obtained from tailings. This is due to some improvements which have recently been introduced, and which increase the yield of gold. The zinc process is of no value for extracting gold from the slimes solution. The electric current, on the contrary, precipitates it easily from even a very dilute solution.

In one year 76,000 tons of acid slimes were treated at the Robinson Mine which on assay averaged 5 dwts. 15 grs. to the ton. This plant has been enlarged. Slimes plants will be erected during the course of this year in several mines in the Transvaal.

A novelty in metallurgy is the oxidation of the pulp by means of compressed air, and in all the slimes plants large low pressure air compressors are installed. The slimes are worked out according to a practical method, which consists in their being coagulated in battery water by means of lime, then in concentration in spitzkasten and in settlement in continuous overflow vats. The pulp is concentrated from ½ per cent. to 7 or 10 per cent. of slimes. There is no possibility of leaching them. They are washed by decantation, and therefore there are from 6 to 8 tons of solution to every ton of slimes, instead of two, as in the case of tailings. The result is that, instead of 4 dwts. of gold per ton of solution, the liquor of the slimes is so diluted that it contains only from 0·001 to 0·01 per cent. of potassium cyanide and from 6 to 24 grs. of gold to the ton. Our authority is the statement of Mr. Charles Butters, who has not only treated the fresh slimes, but has successfully started immense tanks for recovering gold from the old acid slimes. He says: "Precipitation of metals from solutions presents many curious and interesting problems, and one of these is that with the same reagents it is very much more difficult to produce perfect precipitation from a very dilute solution than from a concentrated solution. There are certain chemical and physical laws in connection with this question which are not very well understood. For instance, precipitating from its solution of its chloride by means of ferrous sulphate, a fairly rich solution containing 1 to 4 oz. of gold to the ton admits of a very perfect precipitation if sufficient time is given for settlement, more especially when there are few other metallic salts in solution. A similar solution, but containing only 1 or 2 dwts. to the ton, allows of very imperfect precipitation by ferrous sulphate. In electrolytic precipitation we have a very different set of laws governing the electrodeposition of metals from those which operate in chemical precipitation. In the course of our experiments on the precipitation of dilute cyanide liquors we have tried many methods of precipitating solutions containing 6 to 12 grs. of gold to the ton, but failed completely with such dilute liquor; whereas the same methods acted perfectly on 5 dwts. or 10 dwts. solution. With a dilution of gold down to 6 dwts. per ton, which is about 1 part in 100,000, it would be natural to think if it was 1 part in 100,000 or 1 part in 1,000,000 there would not be a very great difference in the resistance of such very minute proportions of dissolved gold to precipitation, whether by electromotive force or by chemical reaction; but the difference between the action of a liquid containing 6 dwts. per ton and one carrying 6 grs. per ton is most marked, both in chemical precipitation and in electrolytic deposition. In general we have found that we could effect the precipitation of the gold in these dilute solutions best and most economically by means of electrolysis."

The principal points in electrolytical precipitation that it is desirable to study are the amount of current per square foot of anode and cathode, and the time the current is exerted, taken in conjunction with the value of the solution. One of the first points requisite in the electrolytic deposition of gold is that the liquor shall not contain any solid matter; that is to say, that it shall be absolutely clear. The clearness of the solution depends largely upon the solubility of the anode. The iron plate anode in use to-day in the Siemens & Halske boxes, with properly proportioned current, is a very perfect anode, easy to be obtained in any quantity, and as easily manipulated and secured in the boxes. With a current density as low as 0·03 or 0·04 ampere per square foot, very little decomposition of the iron anode takes place. An anode 3-16 inch in thickness and with a current density of 0·035 ampere per square foot should last for five years, and possibly longer. There seems to be a limit of current density up to which an iron anode will show very little corrosion, but beyond that point oxidation seems to take place more rapidly than the proportionate rise of current density would indicate. Where the division of the current has been very carefully studied and regulated very little decomposition of the anode need take place. With the peroxide of lead anode, which was discovered by M. Andreoli in the early part of 1895, practically no corrosion of the anode plate takes place.

It may seem paradoxical to say that the electrolytic methods of the future will differ altogether from those which are at present applied to electrodeposition. But there is no reason to believe that the continuous current is the only one fit for electrochemical purposes. Not very long ago the alternate current and high tension were looked upon with diffidence, even by electricians of universally recognized ability. They reign to-day, nevertheless, and electric lighting, transmission of power, etc., could not in many cases be effected without making use of them. Why should we not assume that we may leave on one side the old electrolytic system, and adopt a new one based on the action of alternating currents and of high tension, in order to obtain in much less time and at a considerably cheaper rate some results with which the continuous current, at present actually used for electrolysis, could not compete? Swan has overruled the laws of electroplating by the use of weak currents, and deposited copper at the rate of 1,000 amperes per square foot of electrode; William Crookes has already treated auriferous ores by the alternating current; their example has now been followed in quite a new direction, and there is no temerity in predicting as an evolution in the application of electrical energy to the separation of metals and to the winning of gold, the use of high tension currents for electrodeposition.

CHARCOAL laid on a burn causes the pain to abate immediately, and by renewing the application will heal and cure—if it is not deep—in a few days.

ENGINEERING NOTES.

The State engineer of New York has let a contract under the new good roads law for the construction of 1¼ miles of road from the Mount Lebanon Shaker village in an easterly direction to the State line, where it will connect with a new road that is being built by the State of Massachusetts. The contract was awarded at $7,290 to the lowest of six bidders.

The largest schooner ever built is now being timbered at the shipyards of H. H. Bean, at Camden, Me., says The American Engineer and Car Builder. The vessel will have five masts and will be 318 feet long on deck, 44 feet 4 inches beam, and 21 feet 6 inches deep. The frames are Virginia oak and the planking Georgia pine. Her masts will be 112 feet long, the foremast being 24 inches diameter and the others 28 inches. The spread of canvas will be 10,000 square yards. This large vessel will be manned by only 12 men. She will have electric lights, searchlight, and steam hoisting appliances.

A suitable kind of concrete for machinery foundations or retaining walls is found to be made by using six parts of broken rock small enough to go through a 3-inch mesh screen, two parts of clean, sharp sand, one part of Portland cement, these to be thoroughly mixed together when dry. No water should be added until the material is required for use, enough being then added to insure a thick mortar, the mixing to be in small quantities for immediate handling, and thorough tamping to be practiced at once. Such concrete will set sufficiently in twenty-hours to carry a load, and in three to four days will be hard enough to run machinery on. In case of difficulty in obtaining broken rock, clean creek gravel of about the same size is a good substitute; but in no case is loam, clay, or very fine sand a desirable ingredient. For special strength more cement may be desirable.

Some of the methods introduced in the tunnel boring for the Jungfrau Railroad in Switzerland, in order to meet the exigencies peculiar to the extreme winter weather, are of special interest to engineers. On this work blasting gelatine is used, an explosive which freezes at about 40° Fah., and, in its frozen condition, is very dangerous to handle, being unlike dynamite in this respect. It seems that the contractors who are blasting out the Jungfrau tunnel keep their explosive in a sort of safe heated by electricity, so that any danger of the gelatine freezing is entirely obviated. Dynamite, or some other derivative of nitro-glycerine, is in very common use for blasting and other purposes, and is commonly frozen for safety. It is usual to thaw it out before it is used, but frequent accidents thus occur, and it is thought that a dynamite thawer operated by electricity would be alike safe and convenient.

Although the technics of safety explosives have made considerable way in Germany, the theory at present received as to the influence of the explosion temperature on the safety of the explosive has obtained but little consideration; and the progress made in this domain during the last few years is almost exclusively confined to practical experiments, while the explosion temperatures of the various explosives have not in any case been determined. These observations are made in "Glückauf" by Bergassessor Heise, of Gelsenkirchen, director of the Braubauerschaft testing station of the Westphalian Miners' Association, and the object of his very full and detailed communication is: 1. To determine by calculation both the explosion temperatures and also the useful effect of the safety explosives in general use. 2. To make known the results of several series of experiments carried out at the above named testing station as regards the safety, explosive action, and shattering effect of the various substances, in order (3) from their results to fully and clearly ascertain the theory of safety explosives.

The jib crane of Mare Island (Cal.) navy yard is an object lesson in the advance of engineering and mechanics, says The Engineering and Mining Press. Its working capacity is forty tons at a 75-foot radius. Without reversing or stopping the engine, it is capable of hoisting, lowering, turning, traveling simultaneously or independently, and is so arranged by differential gearing that the speeds of the outside wheels automatically adjust themselves to the increased radius of the curvature over the inner rail. The traveling speed of the crane is 50 feet per minute; speed of hoisting forty-ton loads, 7 feet per minute; speed of hoisting fifteen ton loads, 15 feet per minute; speed of slewing or revolving complete circle, two minutes. All gears are of steel. Gage of track, 20 feet; total width of car body, 24 feet; height from ground to highest point when boom is elevated, 54 feet; weight of the crane, 200 tons; weight of the counterbalance, 120 tons; hoisting steel cable, $1\frac{5}{16}$ inches diameter; breaking strain, 76 tons. The entire crane rests upon twenty double-flanged wheels, two of the wheels being drivers and all of the wheels being so pivoted that the crane travels around the very sharp curve of 66 feet radius.

The increase in the gold production of the Rand district, which has gone on uninterruptedly since February last, was continued last month, when the total output reached 384,080 ounces, comparing with 376,911 ounces in the preceding month and 262,150 ounces in the corresponding month of last year, an increase of 7,169 ounces in the former case and of 121,930 ounces in the latter. The figures for the past nine months, with the usual comparisons, are shown in the following table:

	1898. Ounces.	1897. Ounces.	1896. Ounces.	1895. Ounces.
January	313,826	209,832	148,178	177,463
February	297,975	211,000	167,018	169,296
March	325,907	232,067	173,952	184,945
April	335,125	235,698	176,707	186,023
May	344,160	248,305	195,008	194,580
June	344,670	251,529	193,640	200,941
July	359,343	242,479	203,873	199,453
August	376,911	259,603	213,418	203,573
September	384,080	262,150	202,561	194,764
Totals	3,081,997	2,152,662	1,674,355	1,711,037

For the nine months the Rand yield, therefore, shows an increase of 929,335 ounces over the total for the corresponding period of last year, or over 43 per cent.

MISCELLANEOUS NOTES.

"**In preparing**, advertising, and issuing the popular loan of $200,000,000 subscribed for last summer, the Treasury Department has expended already more than $200,000," says The Philadelphia Record, "and the total expense account is expected to reach nearly to the limits of the $500,000 authorized by Congress to be devoted to the purpose. Even with this large outlay the Treasury officials declare that the loan is the cheapest ever floated—that is, if no account be taken of the premium which the bonds would have brought if offered originally in the financial markets to the highest bidder."

There is a new process being inaugurated at the Kimberley mines for mechanically sorting out the diamonds which may be of interest to our readers. By this process the sludge from the mills is caused to flow in a thin stream down ribbed troughs, inclined at a slight angle. These troughs are coated with a composition, somewhat of the consistency of black soap, the exact composition of which is, however, kept secret. This composition possesses the power of arresting the diamonds, but permits the other material to flow over its surface unimpeded. On examining the troughs, nearly all the diamonds are to be found sticking at the upper end of the trough, very few finding their way any distance down, and although the waste material is always resorted by hand, it is a very rare occurrence for a diamond to have found its way over with the sludge. The new process is the work of one of the company's engineers, and, besides being much more rapid, possesses many other conspicuous advantages over the old method of sorting by hand.

A few weeks ago The New York Herald summed up the castialties of the war as follows:

CASUALTIES IN BATTLE.

	Officers.	Men.
In Porto Rico—Killed	—	3
In Porto Rico—Wounded	4	36
In Manila—Killed	—	15
In Manila—Wounded	10	88
In Cuba—Killed	23	237
In Cuba—Wounded	99	1,332

The deaths from all causes between May 1 and September 30, inclusive, as reported to the Adjutant-General's office up to October 3, were:

	Officers.	Enlisted Men.
Killed	23	257
Died of wounds	4	61
Died of disease	80	2,485

Being an aggregate of 2,910 out of a total force of 274,717 officers and men, or a percentage of 1.059.

For the benefit of those who appear to be somewhat confused over incandescent nomenclature, the following facts are offered: Vegetable fabric impregnated with a solution of thorium and cerium salts was first used as an incandescent lighting substance by Carl Auer von Welsbach, Carl Auer being the inventor's name and Welsbach his town. Patents were obtained in various countries and purchased by large financial interests known as Auer companies in Germany, France, Austria, etc., and Welsbach companies in England and America. A thorium-cerium mantle is, therefore, known by the name of Auer on the Continent and Welsbach in England and America. This is the rule, whoever makes the mantle specified in Auer von Welsbach's patents. In the case of the British Sunlight Company, the mantle is called the Sunlight because it differs in composition, being principally (originally) zirconium, but wherever the name Welsbach appears in these columns in reference to a mantle it means a thorium-cerium mantle, and nothing more nor less.—Progressive Age.

Raising Coal and Peaches.—Although these two articles of commerce are more or less antitheses of each other, they are being brought together in a singular way in the United States, says Industries and Iron. It appears that considerable trouble has arisen in connection with the surface of land from under which coal has been removed, the farmers' complaint being that the soil is ruined for agricultural purposes. The Ohio and Mississippi Coal and Mining Company, at Marion, Ill., has hit upon a plan for putting an end to surface troubles by growing peaches thereon. The project is in effect a fruit and coal combination, in which the land will be made to produce from fruit farms above and from mines beneath. In Williamson County the company owns 400 acres which is underlaid with a 9-foot vein of fine coal. The project of setting out the entire acreage in fruit trees is being seriously considered. The land is admirably adapted to apples, peaches, and pears. It is proposed to connect all the mines in the vicinity with an electric belt railway, running the line through the main streets of Marion. Within a radius of twenty-five miles there are eight mines. This road will be utilized in hauling the men to and from work, in switching coal, and giving the fruit growers of the adjacent county access to shipping facilities.

On behalf of the Russian War Department, R. Thal has been testing the rubber wraps in which antiseptics and medicines for the army are packed, and especially the glue which is used for sticking this rubber cloth together. This is the first time this subject has been investigated, and the report mentions that inquiries addressed to French colleagues elicited the reply that there did not appear to be much reason for any investigation. We confess that the research seems to justify this opinion, because nothing to which the medical man could take particular objection appears to have been discovered. But every investigation relating to that much neglected substance, rubber, has its interest. Thal had four specimens of rubber glue to deal with, all supplied by the Russo-American Government Works in St. Petersburg. He determined the ashes, mineral residue, sulphur, resins, etc., and, further, the rubber solvent employed. For this latter purpose he extracted the glue with 95 per cent. alcohol, which does not dissolve more than traces of rubber. The best solvents are, in his opinion, toluol, xylol, and higher homologues; a little phenol, further hydrocarbons of the fatty series, acetone, and other setones are admissible in very small quantities. No resins should be added, nor is it customary to add any.

SELECTED FORMULÆ.

To Clean Door Bells, Their Mountings, and Similar Articles.—Der Stein der Weisen recommends plain ammonia water, or this mixed with whiting. Moisten a woolen rag, and with it rub the articles strongly, then rinse. Nothing cleans up old brass as quickly and as satisfactorily. When a large surface is to be cleaned, the best plan is to moisten the surface with ammonia, then, with a good stiff brush, rub strongly, and afterward rinsing it off with clear water and drying.

To Remove Writing from Hectograph Pad.—The Süddeutsche Apotheker-Zeitung recommends for this purpose the crude commercial hydrochloric acid. This is poured over the surface of the mass and then wiped off with a bit of cotton batting. The pad is then held for a moment under a stream of cold water, washed and dried off with a soft cloth. In this manner the surface is quickly rendered perfectly clean, with little loss of substance on a minimum of labor. The pad lasts much longer when thus cleansed than when treated, as hitherto customary, with warm water.

Unguents to Prevent Falling of the Hair.—The Wiener Medizinische Wochenschrift gives the two following formulæ, with approbation:

BAZER'S OINTMENT.

Mercuric oxide, yellow	2	parts.
Sulphur, sublimed	4	"
Oil of cade	15	"
Vaselin	30	"

Mix and make an ointment. A drop or two of any of the attars may be used to perfume, if desired.

LEISTEKOFF'S POMADE.

Tincture of cantharides	3	parts.
Chloral hydrate	2	"
Lanolin	10	"
Vaselin	10	"
Cherry laurel water	10	"
Lime water	10	"

Mix.

The instructions to go with either of these preparations are simply: Apply to the scalp, thinly and lightly, every other night. The head should be shampooed frequently.

FISCHOFF'S LOTION.

Oil of eucalyptus, essential	5	grammes.
Balsam of Peru	5	"
Mixture of balsamic oleos	5	"
Tincture of cinchona, compound	15	"
Alcohol	150	"

Mix.

Directions: Wash the scalp with superfatted eucalyptus soap (or have it well shampooed), dry with a towel, and then rub in the lotion, using the fingers and palm of the hand. Do this before retiring every night, repeating the washing or shampooing every other night.

Hoof Preparations.—1. A good preparation and one that will give the horse's hoof a rapid and healthy growth is to take of oil of tar 1 pint; beeswax, 1½ pounds; whale oil, 4 pints. The above ingredients should be mixed and melted together over a slow fire and applied to all parts of the hoof at least once or twice a week.

2. Neatsfoot oil	4	ounces.
Turpentine	2	"
Oil tar	3	"
Oil origanum	1½	"

HOOF OINTMENT.

1. Suet	100	parts.
Yellow wax	20	"
Black pitch	20	"
Tar	20	"
Lampblack	10	"

2. Equal parts of wax, olive oil, lard, veal suet, turpentine, and honey. Melt the wax, suet, and lard with the oil by a gentle heat; remove from the fire and add the honey and turpentine, stirring till cold. When intended to embellish the hoof, as well as soften it, it may be colored with lampblack or ivory black.

3. Should there be any disease of the hoof, as hoof-bound, etc., the following ointment will produce satisfactory results:

Camphor	1	ounce.
Balsam of fir	1	"
Oil of cajeput	2½	fl. drachms.
Compound tincture of iodine	5	"
Oil of turpentine	1	fl. ounce.
Lard	5½	ounces.

—Era Formulary, from Pharmaceutical Era.

Wood Tar Soap.—The following makes an elegant tar soap:

Wood tar	40	parts.
Ivory soap	60	"
Alcohol	60	"
Water	40	"

Shave the soap fine and put it with the water over the fire. When melted thoroughly, add the tar, and stir till it is evenly distributed throughout the mass. Remove from fire, and let cool down, stirring all the time. When at about 140° F., add the alcohol and stir in. Pour into tin boxes and let cool and solidify. Laundry soap cannot be made by you without considerable machinery and a "plant"—that is, at anything like the price at which you can buy it from any of the big manufacturers.

Honey Cough Candy.—Make up ten pounds of domestic honey candy and add to it, before allowing to cool down, the following:

Tincture of squill	4	ounces.
Tincture of tolu	4	drachms.
Fluid extract ipecac	8	drops.
Oil of wintergreen	8	"
Oil of sassafras	6	"
Oil of anise	3	"

Pour out on a marble slab and cut into small lozenges. You had better employ some candy maker to do this for you, as candy making is not an art learned by following formulæ. The same advice applies to soap making, and, in fact, every technical employment.—National Druggist.

HAMSTER AND POLECAT.

THE favorite haunts of the ratlike hamster are the grain fields in the fertile regions of the temperate climates of Europe and Asia. In these fields the hamster digs dwellings with several cells in which he stores food for the winter. When the hamster desires to leave his habitation, he puts his white head out of the opening in the ground and sniffs cautiously about him. Soon there follows a thick, plump, brownish-yellow body with short legs. Sitting upon his hind legs, the hamster assumes an upright position and glances cautiously around. Nothing suspicious being in sight, his fears are allayed, and he then begins to wash himself, for cleanliness is a pre-eminent characteristic of the animal. After having completed his toilet, he wanders about on all fours seeking food. He gathers grains of corn, stores them in his cheek pouches, and carries them to his subterranean storeroom. But the diet of the hamster is not exclusively vegetarian. He is also fond of animal food, of worms, insects, lizards, snakes; and at times he succeeds in capturing, by a short, quick leap, a young bird or a nimble mouse, which he then devours with relish.

Our hamster in his wanderings has come to the edge of the forest. Suddenly he stops and raises his head. He has heard a suspicious noise. Half hidden by the

A HAMSTER FIGHTING WITH A POLECAT.

roots of a tree, he perceives his deadliest enemy, the polecat. For a moment he seems to consider whether he should seek his salvation in flight or whether he should await the attack of his foe. Cowardice is not one of the vices of the hamster. In spite of his littleness, he possesses a courageous spirit. He will even attack human beings and will at times savagely bite the legs of a man. Our hamster has decided to fight. Ready for battle, both combatants stand facing each other. Now the polecat rushes on the hamster. Snarling and spitting, the hamster repels his enemy with his teeth and claws. Nimbly the polecat turns aside. Leaping about the hamster, now to the right, now to the left, he renews the attack from the rear; the hamster, however, is on his guard and constantly presents his much-feared teeth and claws to his foe. But the incessant attacks of the agile polecat gradually fatigue the fat hamster. His vigilance relaxes. During a renewed onslaught, he leaves his right flank unguarded; the polecat does not allow the opportunity to escape him; he leaps at the throat of his opponent and chokes him, despite the painful wounds inflicted by the claws of the hamster in the death struggle. The polecat drags his prey to his nearby dwelling and lays it on the heap already accumulated. The dead bodies of the putrefying animals here gathered, mingled with the excrement of the polecat, produce an intolerable stench, which is further increased by the disagreeable odor of the polecat itself.

As for the hamster, he is decidedly harmful to agriculture. As a general rule, he steals from twenty to thirty pounds of fruit. Male and female have separate habitations, so that each animal gathers food for itself. Wherever the hamster is found in large numbers, crops suffer considerably. At certain periods and in certain regions the number of hamsters has been inconceivably large. In 1817, for example, from the township of Gotha alone, 117,817 hamsters were delivered to the town officials; and in 1869, 39,000 were caught in the township of Aschersleben. We should, therefore, be thankful to the polecat for coming to our aid in destroying this harmful animal. The polecat is also a keen exterminator of mice and fears not the sharp teeth of rats. Venomous adders, too, are caught and devoured by him.

Nevertheless, the polecat has his bad qualities. An excellent swimmer, he catches fish and crabs and has a predilection for pigeons and chickens. To be sure, the polecat kills usually but a single fowl, which he then drags away; but often he returns several times in a single night and always succeeds in entering a coop. Not unjustly has he been called the proletarian among the martens. His body, however, is fatter than that of the martens, the neck being thicker and more muscular. The good traits of the marten's character are, however, entirely wanting in the polecat. Personal comfort he prefers to everything. He is content with the meanest and dirtiest of habitations. The repulsive odor emitted by him causes him to be shunned by man. He is malicious and savage. His vitality is remarkable, and many a polecat, apparently beaten to death by a hunter, has become reanimated.

In spite of the roughness of the fur, the skin of the polecat, after the disagreeable odor has been removed, is highly prized on account of its beautiful color. A single skin brings from fifty cents to one dollar and a half. According to Lomer, the number of polecat skins annually brought to market amounts to 600,000, from which it may be seen that the industry of preparing the skins is by no means unimportant. The polecat is found in rather large numbers in the temperate zone in Europe and Asia.—Das Buch für Alle.

THE NEW PRISONS OF FRESNES.

THE new group of penal establishments, which the General Council of the Seine handed over to the government about a month ago, is situated upon the territory of the commune of Fresnes, at the place called the Renard Valley, at seven miles from Paris, along the national road running from Choisy-le-Roi to Versailles.

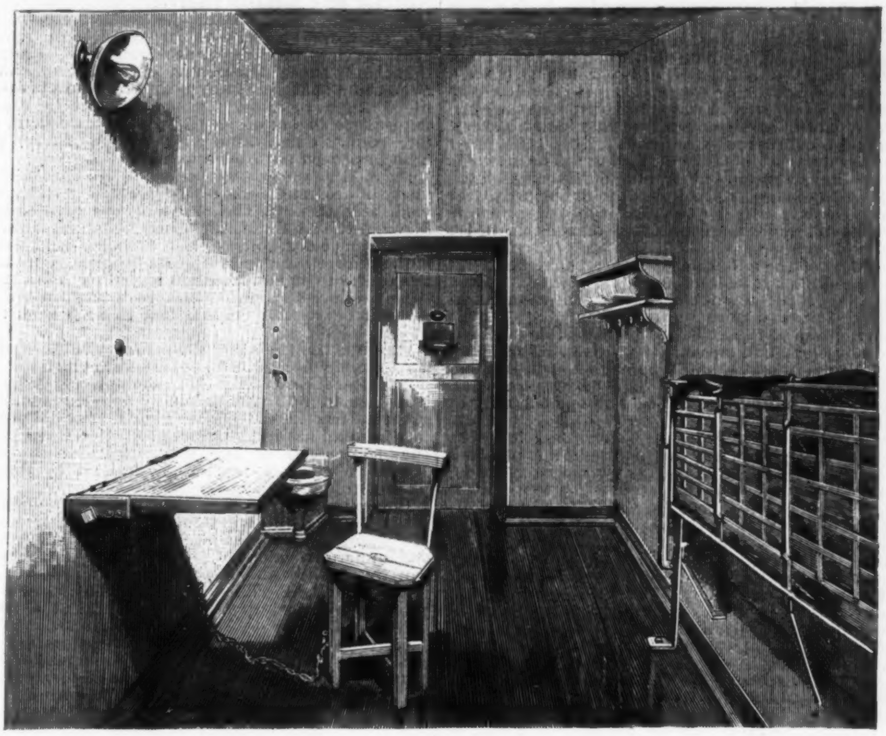
The entrance of the prisons is upon the national road. An avenue bordered with trees leads to the main entrance, which in no respect resembles that of the old prisons. The walls are of tufa, rough-coated with rose-colored cement. After they are finished, these prison buildings will comprise:

1. A central group including, in addition to the general services (such as kitchen, bakery, laundry, and food storehouses, common to the entire group of structures), cell buildings for the 1,500 short term prisoners and spare quarters capable of containing 400 beds.

2. Along and to the right of the avenue leading to the main entrance, an entirely distinct quarter, provided with a special entrance and a patrol wall. This quarter will contain 150 cells and be reserved for prisoners under a sentence of more than one year, for those condemned to close confinement, and for those sentenced to hard labor and who are awaiting their transfer to the central establishments or to the depot on Re Island. It will receive particularly the prisoners now quartered at Grande Roquette, with the exception of those condemned to death, who will finish their last days at the prison of Santé. This quarter will receive the prisoners of note, and be the "antechamber" of the bagnio.

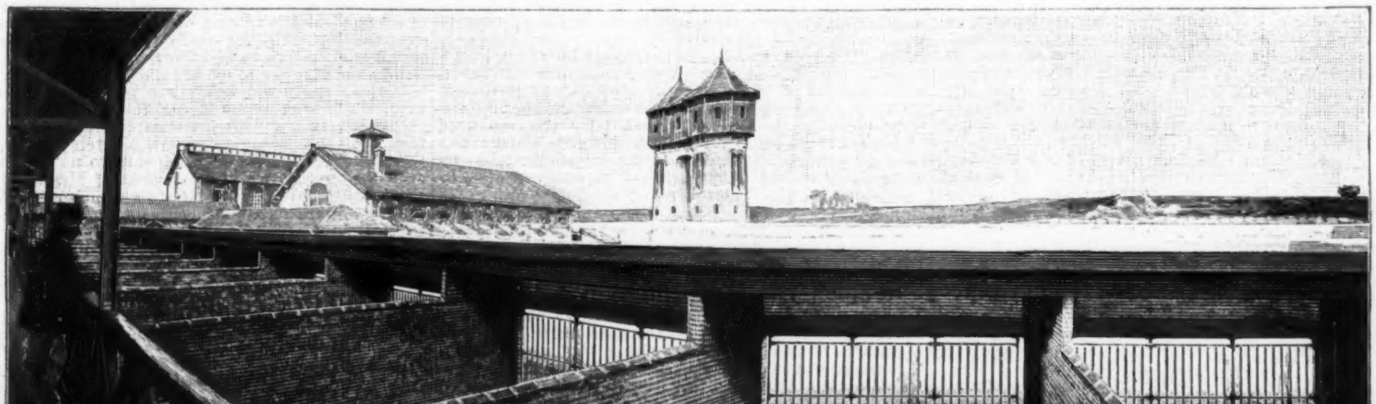
3. To the left of the central building, and symmetrical with the one just mentioned, will be the central infirmary of the Seine prisons (now installed at Santé); that is to say, a genuine hospital, with contagion wards, comprising 100 cell rooms. The infirmary and the second quarter will be finished at the end of this year. The central group is now ready, and it is to this that the gates have been thrown open to public officials, and of which we shall more particularly speak.

As soon as the visitor has crossed the threshold of this prison, his eyes are blinded by the light. A gallery 1,000 feet in length and 40 in width intersects the three divisions at the middle. Very high sunken win-



A CELL.

THE CHAPEL.



EXERCISE YARDS AT THE FRESNES PRISONS.

dows in the vault of the ceiling light this vast gallery, in which the sunlight plays. It would seem as if it had been the purpose, through this flood of light, to render the prisoner more sensible of his privation of liberty. The three cell buildings that compose the confluement quarters, and each of which is capable of accommodating 500 convicts, are parallel with each other at 160 feet distance and situated on each side of the passageway. It will be seen from this that the stellate arrangement (classical in France, and of which Mazas offered the type) has been abandoned in favor of longitudinal buildings placed parallel with each other and separated by spaces 160 feet in width, constituting true avenues in which are disposed the open yards. With this arrangement, the air circulates everywhere and is continuously renewed.

Another innovation is the following: The new cell buildings have a ground floor and four stories. This, say Messrs. Bassinet & Lucipia, in their report to the General Council, will be the first type of prison in France having more than three tiers of cells, inclusive of the ground floor.

The effect of the adoption of this arrangement has been to reduce the cost of foundations, roofing, and piping, since it permits of constructing the same number of cells within a more limited space.

The windows of the cells do not resemble those of the old prisons, but measure 4 × 5 feet. The upper part, which is provided with a movable sash, is alone at the disposal of the prisoner. The lower part, which is provided with ground glass, can be opened only by the keepers.

Let us imagine that we are to be immured for a few months in this prison, and let us see how a person is received here. As soon as the heavy iron barred door closes upon the prisoner, the latter is led to a waiting room, a sort of cage, whence he passes to a hall of inquiry and mensuration. Note is here taken, also, of his physical condition. After these preliminaries, he is taken to the barber shop. The barber of the establishment cuts the hair of the prisoners and shaves them at the rate of forty an hour. In the searching room the convict is relieved of every object that he possesses, and after being stripped as naked as a new born babe, is covered with soft soap and submitted to a shower bath, which cleans him as thoroughly as it is possible. During this indispensable operation, the civil clothing of the convict is sent down through a tube to the disinfecting stove Upon leaving the bath hall, the prisoner, shaved, cropped, combed, scoured, and clad in prison garb, is taken to the cell to which he has been assigned.

These cells have been much joked about, and have been compared to the rooms of our finest hotels. To tell the truth, they are not of very forbidding aspect. We do not find therein "the damp straw of the dungeon." They measure, according to the regulations, 13 × 8¼ feet, with an air capacity of 1,050 cubic feet. The floor is of wood, and all along the edge of it runs a small stoneware gutter. The shelves, the board hinged to the wall and forming a table, and the chair have the aspect of chamber furniture in white lacquer, but all these objects, as well as the walls, are simply covered with white varnish. In one corner there is a folding bed and at the other extremity of the cell there is a privy seat, with an arrangement for flushing the stoneware basin.

A cock is placed against the wall over this seat for supplying water for drinking and toilet purposes. A small 6 or 8 candle incandescent lamp, fixed in a reflector, lights the table.

The solid coating that covers the walls facilitates the cleaning and disinfection of the cell after the convict has left it. As the prisoners are obliged to work during their incarceration, they have to be provided with as much light as possible. This is afforded by the large windows and the electric lamp. Each cell is ventilated mechanically twice an hour. Hot and cold air enter it, according to the season.

In front of each cell there is arranged a yard, 165 feet square, covered with sod and designed for exercise. Herein the convict remains one hour every day. This yard, which is open above for two-thirds of its surface, forms, at one of its extremities, a refuge against the rain or extreme heat.

Along the yards of the third division are constructed, to the left, the school chapel, and, to the right, the correction ward.

The school chapel, which is arranged like an amphitheater, contains 250 cells placed side by side in pairs, and in such a way that the convicts cannot see each other either in entering or leaving, and are able to perceive only the keeper or the instructor. The punishment cell has windows like those of a stable. Things are so arranged that the temporary occupant may receive more or less light or be immersed in complete darkness, according to his behavior. The walls of this cell are covered with gray paint and the sole furniture that it contains is a camp cot sealed to the floor.

Since the convicts are not allowed to hold any communication with one another, under any pretext whatever, the administration has provided isolated chambers for those who are selected for kitchen drudgery, preparing vegetables or washing dishes.

The basements are in part arranged for the use of special workshops.

The general services, such as those of the kitchen, laundry, bakery, disinfection, etc., are distributed to the left of the entrance court. The dwellings of the higher officials and the keepers are scattered in front of and around the prison buildings.

The ground acquired for the construction of these prisons has a surface of about forty acres.

For the above particulars and for the engravings we are indebted to L'Illustration.

NEW RESPIRATORY APPARATUS FOR USE IN MINES.

SINCE the great catastrophes that the mining interest has experienced in recent years in Austria-Hungary much attention has been paid to the question of devising special respiratory apparatus for saving life in cases of fires or explosions in mines.

Respiratory apparatus in general may be divided into two very distinct categories, one of which includes those designed for submarine work and the other those that permit of access to places filled with irrespirable gases. The latter, the only ones that we have to consider here, are divided into two perfectly characterized classes:

Stationary respiratory apparatus, which may be used for work of unlimited duration and movable or life saving apparatus. The first are provided with conduits for the admission of air, while the second are provided with portable reservoirs of oxygen.

Although, under certain particular circumstances, the stationary apparatus are capable of rendering great services in cases of accidents, it is, as a general thing, only those that permit of an active and easy circulation that are of any utility for the operation of life saving to be undertaken when a fire or explosion takes place in a mine. In this study we shall, therefore, confine ourselves to a description of a few of the most improved portable apparatus.

Dr. J. Haldane demonstrated in 1896 that in the majority of accidents most of the victims perish, not immediately through the effect of the explosion, but through the action of the deleterious and suffocating gases, such as carbonic oxide, carbonic acid, etc. He had found that, in certain catastrophes, more than 90 per cent. of the miners killed lost their lives through the poisoning and suffocation resulting from the absorption of gases of combustion, and not from the explosion itself.

It results from this that the majority of those who perish in mine accidents do not die until one hour or two hours after the explosion has taken place. Although it had been found that respiratory apparatus could be of great utility in case of accidents, they did not come into general use in the mines of Austria-Hungary until the appearance of the new apparatus devised by Messrs. Walcher & Gaertner, and called by them the pneumatophore.

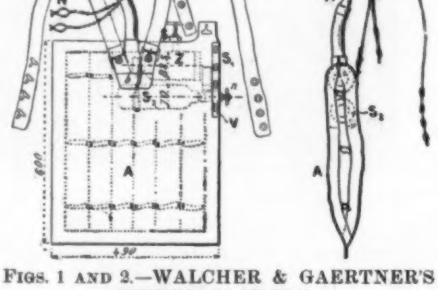
Before entering upon a description of modern apparatus, we think it will prove of interest if we say a few words concerning that of Fleuss, which, owing to the numerous valuable features that it presents, is worthy of study and improvement in order to render its use practical. This apparatus consists of a respiratory bag placed upon the breast and of a reservoir cylinder of compressed oxygen provided with a receptacle especially designed for the regeneration of the air, and carried upon the back of the operator.

The oxygen necessary is led to the respiratory organs by a tube starting from the bag and provided with a valve, while the vitiated air is discharged into the regenerator through a second tube provided with a valve. These two conduits end in a mask hermetically adjusted to the face. The air bag receives through a special tube the purified air coming from the regenerator, and this air then becomes mixed with the oxygen coming from the gas reservoir. What renders the apparatus inconvenient is the large number of conduits that it possesses, and also its weight, which is 30 pounds.

Thus constructed, the arrangement of the different parts devised by Fleuss was very good, for it allowed the person employing it the free use of his hands, the load being almost totally transferred to the back. It must be recognized, however, that the length of the different pipes renders the respiration somewhat difficult.

Having given a few data as to this first practical apparatus, we shall now describe a little more completely the two new types of apparatus that have recently been adopted in Austria-Hungary.

The first, the Walcher & Gaertner pneumatophore, represented in Figs. 1 and 2, consists of a respiration



FIGS. 1 AND 2.—WALCHER & GAERTNER'S PNEUMATOPHORE.

bag, A, and of an apparatus, Z, for the absorption of carbonic acid, of an oxygen flask, S_1, of two pairs of pincers for closing the nose of the operator, and of a special bag designed for receiving the entire apparatus and rendering its carriage very easy.

The air bag is 24 inches in length, 19 in width, and 2 inches in thickness when about half full. It has a total capacity of about 600 cubic inches. It is formed of an absolutely impermeable fabric. As the absorption of the carbonic acid rejected by the operator occurs through a solution of soda, it was necessary that the absorbing surface, wet by the solution, should be as wide as possible. To this effect, there is arranged in the interior of the bag a series of vertical membranes connected in pairs by belts. The apparatus is thus divided into several compartments that communicate with each other. In the center of the upper part is located the respiratory tube, which leads the oxygen to the mouth of the operator, and which terminates in a gutta percha ajutage, but is not provided with a valve. Upon the right side, the bag is provided with a wide aperture, S', that permits of the introduction into the apparatus of the bottle containing the absorbing solution and of the oxygen reservoir. The apparatus is closed hermetically by means of two steel plates backed with India rubber, which embrace the neck of the bottle and are held firmly by binding screws.

The orifice, S', is wide enough to facilitate the complete reversal of the bag, so as to permit of the perfect cleaning of the apparatus after it has been used.

The bottle, Z, Fig. 3, containing the absorbing solution, consists of a perforated metallic cylinder, 8 inches in length and 3 in width, in which is placed a glass bottle containing the solution. The bottle is held at its extremities by cork fittings. It is provided in the center with a metallic ring, with which is connected a threaded cylinder into which passes a screw that breaks the bottle through pressure. This screw is provided with a small hand wheel, S (Fig. 1), as is also the regulating valve of the oxygen reservoir. It is unnecessary to say that these two hand wheels are arranged outside of the bag. The receptacle that contains the absorbent is covered with a fine fabric which, on the one hand, further increases the surface of absorption, and, on the other, prevents the particles of glass derived from the breakage of the bottle from becoming distributed through the apparatus. To the neck of the receptacle is adapted a belt that serves to keep the oxygen flask, S_1, in position. This flask is of seamless steel, 12 inches in length, and capable of withstanding a pressure of 120 atmospheres. Its capacity is about 2 cubic feet.

The pneumatophore is very easily used. The apparatus is held vertically, and the receptacle containing the absorbent is broken by the pressure of the screw upon it. The solution spreads throughout the bag, and, owing to the vertical position in which the apparatus is held, the liquid is prevented from entering the respiration tube. The nose pincers are then adjusted, the belts are passed around the neck, and the extremity of the respiration tube is placed in the mouth with the oxygen valve partly open.

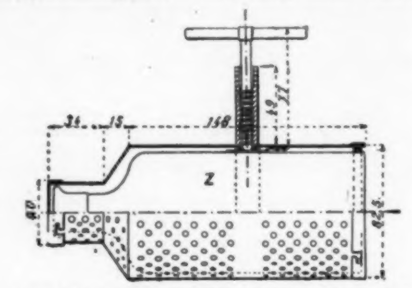


FIG. 3.—SECTION OF THE FLASK CONTAINING THE ABSORBENT MATERIAL.

In this system the respiration is effected exclusively through the mouth, the nose being closed by the pincers in order to prevent the absorption of the deleterious gases. This arrangement, therefore, renders it useless to employ a mask, but, on the contrary, the operator is obliged to provide himself with special goggles in order to protect his eyes against smoke.

The circulation of the air takes place through a valveless conduit, and this greatly facilitates respiration.

FIG. 4.—WORKMAN CARRYING THE COMPLETE EQUIPMENT OF THE PNEUMATOPHORE.

The two principal defects of the pneumatophore are the prevention of speech through the use of the tube running to the mouth and the rendering of the operations of life saving often difficult. In fact, it is evident that in order easily to effect the saving of a life, it is necessary to be able to use the hands and to bend over in order to extend aid to the sufferer.

Despite the few defects here pointed out, the apparatus is remarkable by its lightness and by the slight resistance that it offers to respiration. It weighs, in fact, with complete equipment, but ten pounds.

Another apparatus that appears to us equally valuable for the saving of life is that of Messrs. Mayer & Pilar, constructed by the Neupert Company, of Vienna.

This apparatus consists (Figs. 5 to 9) of an annular respiratory bag, $A\,A_1$, $A\,A_2$, formed of impermeable rubber cloth, and provided with a wide central aperture. Above this aperture is placed a helmet, H, provided with a protective mask, M. The joint of this mask is rendered light by means of a rubber washer that rests internally against the metallic disk of the mask and against a rubber band that surrounds the face. The mask is held by two belts, one of which passes over the operator's head and the other around his nape. It is evident that the apparatus might be used without the smoke helmet, since the joints of the mask are absolutely hermetical; but, since it is very useful in cases of fire, it is better to add it to every apparatus.

The back part of the air chamber, AA_1, does not extend to more than half an inch below the chin, and the breast therefore remains completely free. This greatly facilitates the operator's motions.

The mask is provided in front with two crossed iron

bars, which protect the glass disk through which the wearer looks. As this disk is hinged, the operator is permitted to breathe the surrounding air until the moment at which he reaches the irrespirable gases.

In order to remove the moisture that condenses upon the interior of the glass through the difference of external and internal temperatures, the crosspiece of the mask is provided with a small buckskin ball, *O*, fixed

FIG. 6.

FIG. 5.—MAYER & PILAR'S RESPIRATORY APPARATUS—FRONT VIEW.

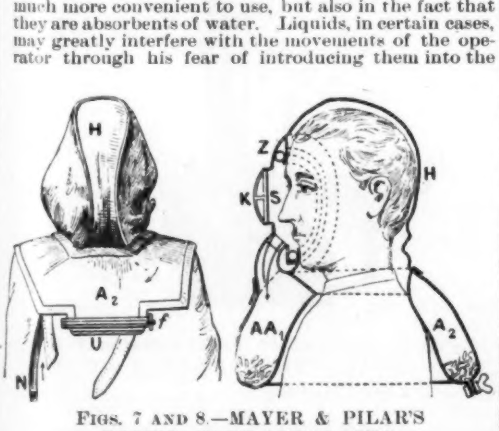
to the center by means of a small rod forming an axis and terminating in an external button. The operator has only to turn the latter in order to cause the ball, through its rotation, to clean the surface of the glass thoroughly.

The respiration is effected through two metallic tubes, *a* and *b*, provided with thin rubber valves that connect the mask with the respiratory bag. The pure air is breathed from the part, A_1, of the bag, through the tube, *b*. The vitiated air, on the contrary, is expelled through the conduit, *a*, into the part, *A*. In order to have a complete isolation of the air breathed in and the air rejected, a partition, *m n*, may be arranged in the bag. Such a precaution, however, is not absolutely necessary, and renders the respiration a little more difficult, since the air is forced to make a wider circuit at every inspiration.

The oxygen receptacle, *B*, is carried at the side through a strap running over the shoulder (Fig. 9). It communicates with the part, A_1, of the air bag by means of a pipe, *N*, which is adapted to the orifice of the oxygen flask by means of a thumbscrew. Its capacity is from 60 to 120 cubic inches, and the oxygen is compressed in it to 100 atmospheres. The substitution of a full for an empty flask is made in a few seconds, thanks to the use of a thumbscrew forming a junction with the supply tube.

The absorption of the carbonic acid rejected with the expired air is effected by means of solid matters preserved in a separate vessel and that are not admitted into the apparatus until the moment at which they are to be used. In order to permit of the introduction of such materials into the respiratory bag, the latter is provided with an aperture, *U*, carrying two iron rods that revolve around a joint and are capable of being tightened against each other by means of a thumbscrew, *F* (Fig. 6). The orifice, *U*, likewise facilitates the rapid cleaning of the apparatus after it has been used.

The materials proposed for the absorption of the carbonic acid are caustic potash, caustic soda, and a mixture of soda and lime. The two first products are found in the market in the form of small sticks, and thus offer a wide surface of absorption. The calcareous soda is in grains. The great advantage that these solid absorbents possess over liquids does not reside solely in the fact that they are more practical and much more convenient to use, but also in the fact that they are absorbents of water. Liquids, in certain cases, may greatly interfere with the movements of the operator through his fear of introducing them into the



FIGS. 7 AND 8.—MAYER & PILAR'S RESPIRATORY APPARATUS.

tubes. The temperature under the mask continually rises in consequence of the air expired, which, saturated with moisture, produces a partial condensation in coming into contact with the sides of the apparatus. Such condensation disengages a certain amount of heat, which then causes a very sensible elevation of temperature. Thanks to the use of solid products which are very deliquescent, a large amount of the humidity is absorbed before its complete condensation, whence results a much less rapid elevation of the temperature. The use of such materials, too, has the advantage of completely eliminating the transpiration that may occur. The temperature of the absorbents, it is true, increases very perceptibly, but without too greatly elevating that of the air. Thus, in several experiments of two hours' duration made with the apparatus, the temperature of the air was found to be from 25 to 38 degrees, while that of the material varied from 31 to 57.

From a purely chemical point of view, the best absorbents are lime and soda; but caustic potassa is preferable, notwithstanding its seemingly less active properties. The advantages presented by lime and soda, in fact, are more apparent than real, for there is another factor that enters into play here, and that is the intensity of the reaction, which is much greater with potassa than with the two other products. It has been found that the proper weight to be employed

FIG. 9.—MAYER & PILAR'S RESPIRATORY APPARATUS—COMPLETE EQUIPMENT FOR LIFE SAVING SERVICE.

is one pound for an operation of two hours. Such weight is sensibly double that theoretically necessary to absorb all the carbonic acid disengaged during this period of time.

The apparatus complete, provided with an oxygen reservoir and absorbent materials, weighs altogether about 15 pounds. It is therefore relatively light and does not discommode the operator very much.

For the above particulars and the illustrations we are indebted to Le Génie Civil.

ARTISTS' COLORS.

WHEN the painters of to-day compare the facilities which they enjoy for their work with those possessed by their predecessors a century or two ago, they must be forced to the conclusion that, so far as material help can go, they have an immense advantage over the ancient masters, says The New York Tribune. In former times, when the artist wished to set his palette he was obliged to take the pigments which he had obtained, often at great trouble, in their crude forms, and either grind them himself or have this operation performed by a boy who was usually both his servant and pupil. The process of grinding up the dry substances in oil was a slow one, but the results obtained by it were good. The grinder procured two flat slabs of stone, and, placing the pigment between them, he first crushed it to the form of fine powder, and then, adding oil enough to make a soft paste, he continued the grinding by rotating the upper stone upon the lower until the mixture was reduced to perfect smoothness and the exact consistency which experience had proved to be desirable. This whole process had to be repeated frequently, to have the colors fresh, and because of the importance of having pigments of good quality, the most celebrated painters used to give their personal attention to the work, thereby spending much time upon the preparation of materials which, under different conditions, they might have devoted to the painting itself.

The modern artist, who is able to buy any color he needs, put up in an airtight tube, ready for use, has no occasion to occupy himself with the grinding or with any other of the processes of manufacture. Frequently he knows nothing about how pigments are prepared, and buys them under the labels put upon them by manufacturers without knowing even of what they are composed. Many of the most famous painters, however, anxious that their works shall be achieved in materials which will stand the effects of light and age, have made a study of the chemistry of colors, and, although they do not prepare them, are perfectly acquainted with their composition, and insist upon having exactly the kinds that they consider best.

Many American artists still prefer the foreign colors, because these are usually made by hand. Tradition asserts that this is the surer way, but it is necessarily slow and expensive. There is no reason why machinery will not do the grinding equally well, perhaps even more smoothly than the hand process, but the point regarding which some painters are still anxious is that of overheating. By the action of the machines a certain amount of heat is generated, and if this is not counteracted before it becomes too great, the pigments and the oil are likely to be injured by it—an injury which would not perhaps be visible at first in the color, but would cause it to disintegrate or darken in the course of time. Methods of cooling the machinery are practiced with success, but some painters are still a trifle skeptical, and prefer to trust to the foreign handmade colors.

Of these, the pigments prepared by Edouard, of Paris, are regarded as of especially excellent quality, and are used, at least for their finer work, by some of the best-known New York painters. The hand process of to-day differs little from that of old times. But there is an ever-increasing demand for American machine-made colors, and artists are outspoken in their praise of them. The utmost said against them is that they have not yet been subjected to a sufficiently long test of time to enable it to be positively known how they will last.

Indeed, the comparison of modern colors with those of three or four centuries ago has given rise to much argument and difference of opinion. It is urged in favor of the pigments of to-day that they are manufactured with a more intelligent regard to chemical purity than in former times, and that consequently they ought to be and doubtless are more permanent. On the other hand, it is alleged that the almost universal custom of adulterating expensive articles with cheaper substances is probably practiced now to a certain extent with paints, and that this must be allowed for somewhat in counting upon modern colors. Another point worth noting is that new pigments are continually being discovered, and it may well be that some of these shall prove perishable after they have been tried by the lapse of years.

J. G. Vibert, the famous French painter, has made the chemistry of colors an especial study and has written a book, "La Science de la Peinture," which deals at length with the qualities of different pigments. His book is regarded as an authority by most artists, and some of his statements are consequently of the greatest interest. The ancient painters, he says, of the time of Apelles, had only four colors: Chalk white, yellow ocher, red ocher, and black. In Pliny's time the number had been increased by different kinds of chalk whites, lead white and its combinations, massicot, minium, orpiment (red and yellow sulphuret of arsenic), red and purple lakes (made from shells), natural and burnt ochers, cinnabar, indigo, powdered Emaux blue, verdigris, brown earths, ivory black and other blacks, and sepia. Later came the red lakes, made from cochineal, from certain woods and from madder; yellow lakes, made from "graine d'Avignon" (French berry) and the true ultramarine blue, made by grinding up the costly stone lapis lazuli.

The writer goes on to speak of a chest, now in the Museum of Antwerp, which was formerly the property of Rubens, and contains a collection of the colors with which that celebrated painter used to lay his palette. They include most of those mentioned above. In commenting upon the choice of colors by the artists of the time of Rubens, Vibert says it is worth noting which pigments have lasted best. White lead, cinnabar, lapis (ultramarine), the madder lakes, the earths and the ochers have all withstood the years well, but all the vegetable yellows, reds, and greens have faded and become lost, chiefly through the effects of light.

Since Rubens, says the author, many colors have been discovered and invented, unfortunately often more brilliant than lasting. The discovery of aniline as a base for different pigments was, he says, a great misfortune for art. By the use of wax, oil, and aniline it is possible to compound a coloring substance which shall appear excellent, but which in reality is largely a sham, the three substances mentioned serving to take the place of the actual pigment, and being greatly inferior to it. The finest colors, in a word, are those composed of nothing but the pure pigment, softened with a small quantity of linseed or poppy oil as a medium. Owing to the tendency of even the purest vegetable oil to become dark, experiments have been made with other mediums, among which petroleum has been used successfully.

Vibert comes to the general conclusion that most of the colors made from vegetable substances are bad because they are destroyed by light and by combination with mineral products. The mineral colors are generally permanent, but it is hard to procure them in a state of perfect purity. The fact that untrustworthy colors are often disguised under various names and that certain pigments are bad if used alone, but harmless and desirable when combined with others, makes it highly advantageous, thinks Vibert, that an artist should understand the chemical properties of his materials and be able to test them for himself.

The oldest and largest paint-manufacturing house in the United States, which makes a specialty, among its other work, of preparing artists' colors, is in New York. The colors which bear its name are considered the best made in America, and many artists think them equal to any of foreign manufacture. After the reducing of the crude pigments to powder, the grinding in oil and preparation for market are accomplished. The powder is first put into buckets with the proper quantity of oil, and mixed thoroughly by means of an instrument somewhat like the dasher of a churn. This revolves slowly in the pail, constantly stirring the powder and oil together.

When well mixed, the color is taken out and put into the mill which grinds it. This acts upon the usual principle of grinding-mills, crushing the substance between upper and lower stones. Great pressure is brought to bear upon the coloring matter, but the machine is made to work slowly, and the whole apparatus is constantly cooled by means of a flow of water, in order to prevent the heating of the mixture. The color oozes out as soon as ground, and drips into a pail placed to catch it. The rate at which the grinding proceeds may be understood when it is stated that one mill can turn out only about enough to fill a small tube in a minute, and that it requires from four to six hours to grind a 30 pound pailful of color.

After this operation is finished the mixture is poured into cans, from which the little tubes are filled. These cans have an opening in one side near the bottom. When a slight downward pressure is exerted by a movable cover, which rests upon the surface of the paint, some of it is forced out into a tubelike faucet which projects through this opening. The faucet is a trifle smaller than the paint tube, which is thrust over it as it projects, and drawn off again instantly, filled with the color. The work can be done rapidly, and the tubes are then sealed up by having their ends doubled over three or four times, in the way they are always seen in the shops. This is done by another machine, ingeniously devised for the task.

The prices of the different colors vary greatly, owing to the high or low values of the raw materials used in each, and also, in some degree, to the amount of oil which the different substances will take up. The more oil that is used, the less of pigment will have to be em-

ployed, and as the oil is much less expensive, colors which will absorb a large percentage of it are cheaper to make. The madders, which are the most expensive of generally used colors, are worth from $12 to $20 a pound in the dry powder. They take up half their weight of oil in mixing, but in spite of that they are very expensive when finally prepared in the tubes. Cobalt, worth $8 a pound in powder, is another expensive color, but the prices of most of the other pigments range lower—from $1 to $2 down to five cents a pound in the dry state. The earths and clays, such as the siennas, are the cheapest colors used. Ultramarine ash is a pigment made from the powdered fragments of the mineral lapis lazuli left over after the stone has been cut for jewelry or other decorative purposes. It is a light grayish blue, but is not much used now on account of its costliness, being worth $30 a pound. The color usually sold now as ultramarine is not made from lapis lazuli, but from a combination of silica, alumina, soda, and sulphur.

THE LIQUEFACTION OF GASES.

LAVOISIER, seeking the conditions that are capable of increasing or reducing the mass of the atmosphere, supposes the earth to be moved nearer to the sun, into the warm regions in which Mercury, for example, is located, and shows that, in such a situation, the whole of the water, as well as other bodies, would be converted into vapor, and that the air would thereby be augmented. If, on the contrary, the earth were moved into very cold regions, the water that now forms our rivers, seas, and the liquid that we know would be converted into very hard rocks. The air or some of its parts would cease to exist in the state of elastic vapor for want of an adequate degree of heat, and there would result therefrom new liquids of which we have now no conception. It was for Faraday, through the most brilliant experiments, to realize these suppositions of Lavoisier and to convert all the known gases into liquids, the extraordinary properties of which had escaped all previsions.

The first systematic researches upon the liquefaction of gases are, in fact, due to Faraday. Into one of the branches of a U-shaped tube of small size and closed by a lamp, Faraday put substances capable, through the action of heat or through chemical reaction, of giving a large volume of the gas to be studied. This latter, thus inclosed in a small space, was compressed and liquefied in another branch previously cooled.

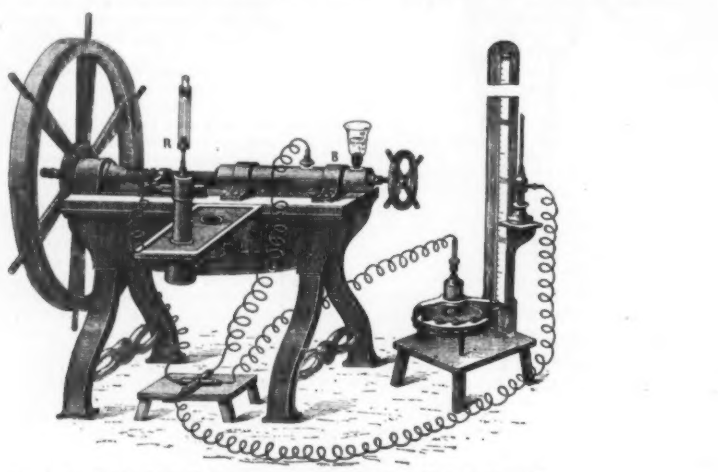


FIG. 1.—CAILLETET'S COMPRESSING APPARATUS.

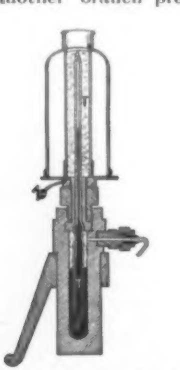


FIG. 2.—DETAILS OF THE CAILLETET RECEIVER.

The sulphurous and carbonic anhydrides, sulphureted hydrogen, hydrochloric acid, protoxide of nitrogen, cyanogen, chlorine, and ammonia gas were thus liquefied for the first time by Faraday in 1823. In 1834, Thilorier applied Faraday's method to the liquefaction of carbonic anhydride on a large scale. He caused a reaction of sulphuric acid and bicarbonate of soda in a bronze receptacle communicating with another vessel identical with the first and in which the carbonic acid liquefied. Upon abruptly opening the last-mentioned vessel in the free air, the liquid escaped and immediately solidified into a snow of which several pounds could be collected at once. As this snow upon evaporating freely in the air furnishes a temperature of —79°, Faraday, upon resuming his former experiments in 1845, utilized it as a refrigerant. Upon mixing it with ether and submitting the whole to the action of a vacuum, he obtained a temperature of —110°, and, under such conditions, with pressures of 50 atmospheres, was enabled to liquefy ethylene, fluoboric and fluosilicic acids and phosphureted and arseniureted hydrogen. He also solidified hydrobromic, hydriodic, sulphurous, and hydrosulphuric acids, protoxide of nitrogen, cyanogen, and ammonia gas. Hydrogen, oxygen, nitrogen, binoxide of nitrogen, oxide of carbon and formene alone could not be liquefied, and these were therefore called "permanent" gases.

In 1850 M. Berthelot endeavored to liquefy these so-called permanent gases by inclosing them in the upper part of a mercury thermometer with very thick and strong walls. By expanding the mercury through heat, he was enabled to compress them thus to pressures bordering upon 800 atmospheres; but no liquefaction took place.

Later on, in 1861, Andrews compressed the same gases in such a way as to reduce them to less than $\frac{1}{500}$ of their volume; but his experiments likewise were fruitless, although he had taken care to effect the cooling with Faraday's refrigerant mixture. However, some other observations of the same physicist threw a new light upon the question. Taking up some experiments made by Cagniard-Latour in 1821, Andrews showed that above a certain temperature called "critical," variable with the substances under experiment, gases cannot assume the liquid state, whatever be the pressure to which they are submitted. Thus, for example, carbonic anhydride can exist only in a gaseous state. This explains the want of success of the experiments made upon the permanent gases. The mixture of carbonic snow and ether had not furnished a temperature sufficiently low to permit of getting below their critical temperature. The pressure, as great as it was, did not suffice to bring about the liquefaction, and it was therefore necessary to seek more energetic methods of cooling.

Such was the state of the question when, in 1877, oxygen was liquefied simultaneously, and by entirely different processes, by M. Cailletet, in France, and M. Raoul Pictet, at Geneva.

The Cailletet compressing apparatus is shown in Fig. 1. The principle upon which it is constructed is as follows: A steel plunger, passing through a leather collar, enters a steel cylinder, *B*, of which the walls are sufficiently thick to withstand pressures of 1,000 atmospheres. The free extremity of the piston terminates in a screw with square threads that enters a nut which is fixed to the center of a hand wheel. Upon revolving the latter, the piston is made to enter the cylinder, *B*, which is filled with water. This water is then forced, through the intermedium of a flexible metallic tube, into a receiver, *R*, the details of which are shown in Fig. 2. This is a hollow cylinder provided at its upper part with a screw thread upon which is adapted, by means of a nut, a glass reservoir, *T*, which contains the gas to be liquefied. This reservoir, or "laboratory tube," consists of a thick capillary tube soldered through its lower part to a wider tube. It is this wide part that plunges into the mercury contained in the hollow cylinder. This mercury, compressed by the water, rises in the laboratory tube and compresses therein the gas with which it has been previously filled.

Fig. 3 represents a laboratory apparatus which also was constructed by M. Cailletet. The receiver here is absolutely the same as the preceding, but the compressor differs in that the screw press is replaced by a piston pump that permits of obtaining pressures running up to 300 atmospheres. For greater pressures, a handwheel, *V*, actuating a piston, is maneuvered. Another handwheel, *V'*, permits of abruptly stopping the pressure, which is read upon a gage, *M*.

Upon compressing acetylene in this apparatus, M. Cailletet made an interesting observation. When the capillary part of the laboratory tube is cooled to the vicinity of zero, if we suddenly expand the acetylene gas, compressed to a pressure less than that which determines its liquefaction, we shall see a fog immediately filling the tube and disappearing almost as suddenly. The abrupt expansion produces a degree of cold sufficient to liquefy the acetylene gas despite the low pressure that prevails in the apparatus. M. Cailletet then repeated this experiment with the permanent gases. Binoxide of nitrogen and formene compressed and then expanded under the same conditions furnished in the laboratory tube a fog identical with the preceding. Oxygen and oxide of carbon, compressed to 300 atmospheres in the tube, cooled to 29° by means of liquid sulphurous gas, the evaporation of which was hastened by a current of air, were abruptly expanded and gave the same results. Nitrogen and hydrogen thus furnished through expansion a fog that filled the tube and suddenly disappeared.

On the very day upon which M. Cailletet presented to the Academy of Sciences the memoir describing the splendid experiments that we have just recalled, M. Pictet, of Geneva, announced that he had just liquefied oxygen, in employing, for obtaining low temperatures, a process absolutely different from the preceding. M. Pictet profited by the cold produced by the evaporation of sulphurous anhydride for liquefying and solidifying carbonic acid gas. The evaporation of the latter being quickened by the action of a pneumatic apparatus, there was obtained a temperature estimated at —130° and lower than the critical temperature of oxygen. This is what is called the "cascade process," or that of successive falls of temperature.

The method would prove onerous if one allowed the vapors coming from the liquids successively employed to be lost. So M. Pictet produced a circulation of sulphurous anhydride through a receptacle for the liquid sulphurous anhydride, a pump to cause a vacuum upon this liquid and hasten its evaporation, and a condenser in which the vapors sucked up were liquefied in order to re-enter the receiver and undergo anew the same transformations. An absolutely analogous arrangement kept up also a continuous circulation for the carbonic anhydride. A very thick walled tube, plunged into the carbonic snow, was connected with a shell containing chlorate of potash. This shell was heated to a temperature of about 480°. A pressure gage arranged upon the apparatus showed the beginning of the reaction. At the end of an hour the pressure reached 526 atmospheres and soon fixed itself at 470. There was now oxygen condensed in the tube, since, upon opening the orifice arranged to this effect, there was observed a liquid jet that lasted three or four seconds.

The experiments of Messrs. Cailletet and Pictet showed that the permanent gases are all capable of being liquefied. There was occasion, however, to try to obtain them and preserve them in the state of stable liquids, characterized by a meniscus that may be observed in transparent vessels. It was necessary to determine their boiling points and all their physical constants. These are the problems that have been attacked by the various experimenters that since 1877 have occupied themselves with the liquefaction of gases and the production of low temperatures.

Prof. Wroblewski, of the University of Cracow, who had been following up Cailletet's experiments at the Ecole Normale Superieure, and had initiated himself into this kind of research, did, in conjunction with his colleague Olzewski, some interesting work in this line.

M. Cailletet had pointed out that ethylene, boiling at the pressure of the atmosphere, produces a temperature of —105°, much less, consequently, than that of carbonic snow placed under the same conditions. Messrs. Wroblewski and Olzewski, forming a vacuum on this liquid ethylene, obtained a temperature of —136°, which was sufficiently low to permit them to liquefy oxygen completely. They were the first to obtain this element in the form of a stable liquid presenting an entirely distinct meniscus. At this same temperature, nitrogen, first compressed and then slowly expanded to 50 atmospheres, liquefied and presented a well defined meniscus. Oxide of carbon behaved in the same manner.

Later on, the same experimenters, each working separately, upon evaporating nitrogen cooled with boiling liquefied oxygen, obtained the element in a solid state.

Prof. Wroblewski fixed the temperature of ebullition of the new liquefied gases as follows:

Oxygen	—184°
Air	—192·2°
Nitrogen	—193°
Oxide of carbon	—186°
Marsh gas	—164°

All the permanent gases except hydrogen had now been obtained in a liquid state, but with this gas the question had not progressed so happily. In 1884 Messrs. Wroblewski and Olzewski put to profit the intense cold that they were able to obtain with oxygen and nitrogen boiling under a reduced pressure. Compressing hydrogen in a tube cooled by this process and afterward abruptly expanding it, neither experimenter

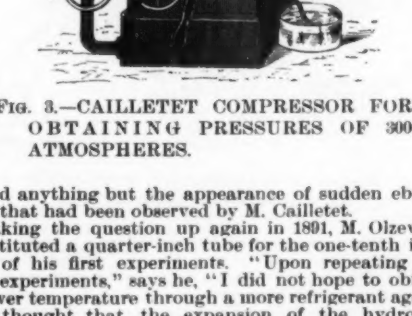


FIG. 3.—CAILLETET COMPRESSOR FOR OBTAINING PRESSURES OF 300 ATMOSPHERES.

found anything but the appearance of sudden ebullition that had been observed by M. Cailletet.

Taking the question up again in 1891, M. Olzewski substituted a quarter-inch tube for the one-tenth inch one of his first experiments. "Upon repeating my first experiments," says he, "I did not hope to obtain a lower temperature through a more refrigerant agent, but thought that the expansion of the hydrogen would be more efficacious, because the experiment was performed upon a larger scale. The phenomenon of the ebullition of the hydrogen that was then observed was much more marked and of much longer duration than it was at the time of my first experiments in this direction; but I perceived no meniscus of liquid hydrogen."

In 1895, four years afterward, M. Olzewski announced that he had finally been able to determine the critical constants of hydrogen and to fix its temperature of ebullition. Upon forming a vacuum upon liquid oxygen, this scientist obtained a temperature that he estimated to border upon —211°. Now, upon expanding hydrogen cooled to this low temperature, M. Olzewski

saw the ebullition occur invariably under a pressure of 20 atmospheres, whatever might have been the initial pressure—80, 100, 120, or 140 atmospheres. A pressure of 20 atmospheres is the critical one. In a steel flask, then, in the middle of which there was a platinum resistance designed for measuring the temperatures, M. Olzewski expanded some hydrogen coming from a tube of several cubic inches capacity in which it had been compressed to 170 atmospheres. The pressure remaining stationary in the flask at 20 atmospheres, there was observed for a few instants a constant temperature of —230°. The same pressure having been reduced to one atmosphere, the temperature fixed itself at —234·5°. M. Olzewski concludes by saying that the critical pressure of hydrogen is 20 atmospheres, its critical temperature —234°, and its temperature of ebullition —234·5°.

Commenting upon these results, Prof. James Dewar remarks that M. Olzewski's experiments were made upon a substance that he unfortunately could not see under these circumstances, and that was supposed to be present for one or two minutes at the most, at the moment of the expansion of the gaseous hydrogen in the steel flask. It was for the English scientist definitely to solve the problem of the liquefaction of hydrogen, and obtain this element in the form of a stable liquid replacing the fugitive fog that had been observed by other experimenters.

Prof. Dewar had already, for several years, been making interesting researches upon the liquefaction of air and the production of low temperatures. In 1895 he presented to the Chemical Society of London a laboratory apparatus constructed with a view to preparing notable quantities of liquefied air. The same problem had been taken up and solved at Leyden by Prof. Kammerling Onnes, who employed in succession chloride of methyl and ethylene as refrigerants.

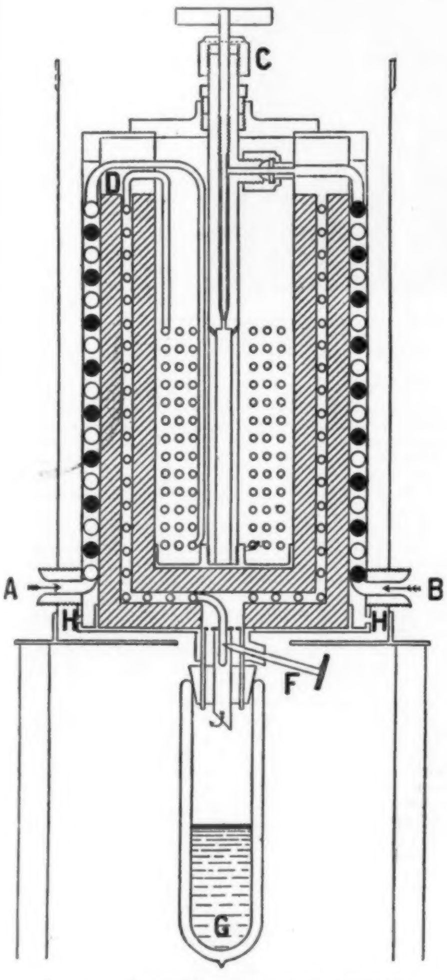


FIG. 4.—DIAGRAM OF THE DEWAR APPARATUS.

A, air or oxygen inlet; *B*, carbonic acid inlet; *C*, valve for the expansion of the carbonic acid; *D*, spiral for the recuperation of the cold; *F*, valve for the expansion of the oxygen; *G*, tube containing the liquefied gas; *H*, exit for the carbonic acid and oxygen; *O*, tubes for the passage of the air.

Prof. Dewar contents himself with a single refrigerant, carbonic snow at —79°, without evaporation. The air, previously compressed in a steel tube, passes through a worm cooled with carbonic snow, and afterward makes its exit through a small aperture at a pressure of 100 atmospheres. A diagram of the apparatus is represented in Fig. 4. As for the receptacle in which the liquid air is collected, that consists of a glass vessel with two walls separated by a space devoid of air. The internal wall is silvered so as to prevent the access of heat by convection and radiation.

The liquefied air thus obtained has been utilized by Prof. Dewar for performing a certain number of experiments. He employed it as a refrigerant in the researches that he made in conjunction with M. Moissan upon the liquefaction of fluorine. Putting liquid air into a silvered receptacle and submitting it to the action of a vacuum, Prof. Dewar saw the liquid gather up into a mass. At least thirty cubic inches of solid air were thus obtained in the form of a white and transparent jelly. This latter having been placed in a magnetic field, the liquid oxygen was observed to direct itself toward the poles. This fact seems to indicate that one had to do simply with a paste of solid nitrogen in liquid oxygen.

Liquefied air has been employed also in the solidification of binoxide of nitrogen. There is obtained a white solid which always, upon fusion, gives a blue liquid.

All these researches naturally led Prof. Dewar to attempt, on his part, the liquefaction of hydrogen. The experiments made by him in this direction, with an apparatus that he has not as yet described, have fortunately been successful. "Finally, on the 10th of May," writes he in a communication made to the Academy of Sciences on May 16, 1898, "upon operating with hydrogen cooled to —205° C. and at a pressure of 180 atmospheres, escaping at the extremity of a spiral tube into an empty vessel, doubly silvered and of special construction, placed in a space kept at a temperature of less than —200°, the hydrogen began to flow from the empty vessel into another doubly isolated by a third empty vessel. In about five minutes two cubic inches of liquid hydrogen were collected." In this way there was obtained a clear and colorless liquid that presented no absorption spectrum, but appeared to have a very high dispersion and index. As for its physical constants, these Prof. Dewar has not been able to determine. Its temperature of ebullition in particular has not yet been fixed, but two experiments show that it is extremely low.*

A long glass tube, closed at one extremity and open at the other, having been plunged by its closed extremity into liquid hydrogen, solid air was immediately seen depositing in the cooled portion of the tube.

A balloon terminating in a slender tube sealed with a lamp was filled with helium. When the tube was plunged into liquid hydrogen, one observed the production therein of a liquid which was nothing else than liquefied helium. This was the first time that helium had been obtained in a liquid state.

Finally, having renewed his experiment of the 12th of May, Prof. Dewar obtained three cubic inches of hydrogen. Into this he plunged some cotton, which, on being taken from the apparatus, ignited and burned with a large hydrogen flame. This same cotton, saturated with liquid hydrogen, and placed between the two poles of an electromagnet, showed itself strongly magnetic, doubtless on account of the solid air formed and deposited upon its surface.

Such are the interesting results communicated by Prof. Dewar, and which will certainly be conspicuous in the history of contemporaneous physics. With hydrogen employed as a refrigerant, we attain from 20° to 30° of absolute zero, and a new field is opened up to scientific researches for the study of the properties of matter in the vicinity of absolute zero.

The study of liquefied air has led two other English physicists, Messrs. William Ramsay and Morris W. Travers, to results of an entirely different order, but which are no less interesting than those obtained by Prof. Dewar.

In the researches of these gentlemen, the liquefaction of the air was obtained by means of an apparatus devised by Dr. Hampson. Making an ingenious application of the principle of cooling by expansion, Dr. Hampson uses no foreign refrigerant, the cooling by the expanding gas alone sufficing for the production of liquefaction. There are arranged three concentric spirals (Fig. 5), each formed of a copper tube, and all being connected. The gas debouches at *A* into the external spiral under a pressure of 120 atmospheres, traverses the two other spirals, and expands at the extremity, *G*, of the internal spiral. It afterward traverses in succession the annular compartments in which the spirals are placed, and makes its exit at *R*. The gas entering this apparatus is therefore cooled while it is passing through the spirals and is still under pressure. With such an apparatus, measuring 28 inches in height and 7 inches in diameter, Dr. Hampson obtains, at the end of half an hour, 1·1 cubic inches of liquid air per minute.†

Messrs. Ramsay and Travers have prepared large quantities of liquefied air by means of this apparatus. Forty-five cubic inches of this liquid were gently evaporated until there no longer remained anything but a residuum of 0·6 cubic centimeter. The gas disengaged from this residuum was collected in a receptacle, and after treatment with copper in the hot way, in order to remove the oxygen, and with a mixture of lime and magnesium in order to absorb the nitrogen, there remained but 15·75 cubic inches of a gas which, in addition to the feeble spectrum of argon, presented one that had never before been observed. This spectrum is characterized by two very brilliant lines very near *D*, and also by two green lines ($\lambda = 5566·3$ and $\lambda' = 5557·3$). Mr. Ramsay, to whom we owe the discovery of argon in the air, again found himself confronted by a new element.

The density of this gas, approximately measured, has been found equal to 22·47, the density of oxygen being equal to 16. There has also been determined, as for argon, the wave length of sound in this gas. The figure found permits of estimating the ratio of the specific heats, and it has been concluded therefrom that the new gas, like argon and helium, is monatomic.

Upon the whole, Messrs. Ramsay and Travers conclude from their observations that atmospheric air contains a gas that has hitherto been unknown and that exhibits a characteristic spectrum. This gas, which is heavier than argon, is less volatile than nitrogen, oxygen, and argon. It is monatomic, and consequently a simple body. The two experimenters propose to call it krypton, that is to say, "hidden." Its symbol is K.

This discovery of a new element in the atmospheric air was communicated to the Academy of Sciences at its session of June 6.

A fortnight afterward, at the session of June 20, the two English physicists announced the presence in the air of two other gases that had up to then been unknown. The same application of the principles of fractional distillation had furnished them new and interesting results. Eleven hundred cubic inches of argon, or, better, of atmospheric gas, freed from nitrogen and oxygen by the ordinary processes, were liquefied and submitted to slow evaporation. The first products of distillation collected furnished a Geissler tube with a brilliant orange-red light characterized by very bright new lines, especially in the red and yellow. The interposition of a Leyden jar produced the extinction of certain red lines, while new lines appeared in the blue. This new spectrum, thus observed for the first time, characterizes an element that the two experimenters have called neon ("new"). They have determined an approximate value of its density and have found the figure 14·67, that of argon being 19·95.

The distillation of argon having been pursued, there remained toward the end a solid product which volatilized slowly and was consequently easily obtained in a pure state. In the gaseous state, the density of this is 19·87, very near that of argon. It exhibits a characteristic spectrum with a peculiar green and yellow line. To this new gas Messrs. Ramsay and Travers give the name of metargon. Like argon, helium, krypton, and neon, it is monatomic.

Thus, to the elements known up to the present as constituents of the atmospheric air, we have to add three others—neon, krypton,* and metargon—which had escaped the researches of chemists. The splendid discoveries of Messrs. Ramsay and Travers suffice to show the interest presented by the practical realization of low temperatures and the liquefaction on a large scale of what were formerly called "permanent gases." New methods of research are now at the disposal of scientists, and the results that we have just made known permit of the anticipation that they will prove fruitful.—Raymond Jarry, in Revue Encyclopédie Larousse.

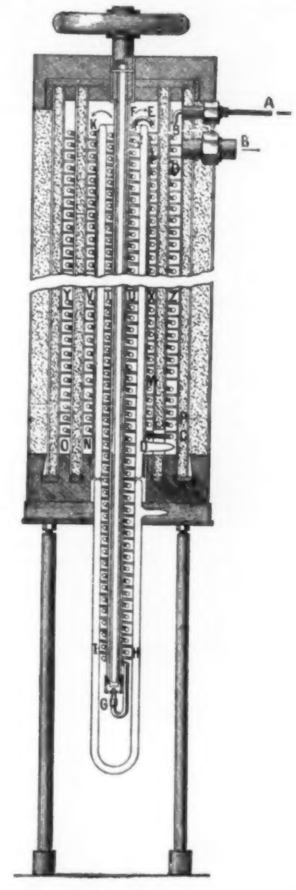


FIG. 5.—DIAGRAM OF DR. HAMPSON'S APPARATUS.

The gas arriving at *A* enters the external spiral at *B*. It makes its exit at *C* and passes into the second spiral at *D*. Finally, it makes its exit at *E* and enters the internal spiral at *F*. Upon reaching *G*, it expands and passes through the chambers *H*, *I*, *J*, *K*, *L*, *M*, *N*, *O*, *P*, and *Q*, and the tube, R.

* Prof. Dewar, in a communication to the Royal Society of London, has pointed out a few of the physical constants of liquid hydrogen. In particular, its temperature of ebullition, at the pressure of the atmosphere, has been estimated at —238°. A platinum wire having a resistance of 5·338 ohms in melting ice presented a resistance of but 0·129 ohm when it was plunged into boiling hydrogen. The law of variation of the resistance of this wire with the temperature having been previously studied, it will be seen that it was possible in this way to fix the temperature of ebullition of the hydrogen. Upon evaporating liquid hydrogen in a vacuum, it will be possible to lower its temperature to about —250° C., say about 200° below absolute zero. As for the density of liquid hydrogen, Prof. Dewar has found that to be in the vicinity of 0·07. This figure is very low in view of the fact that liquid marsh gas (the lightest of all known liquefied gases) exhibits a density of 0·417 at its point of ebullition. It is interesting to remark, also, that hydrogen occluded in palladium has a density of 0·62, that is to say, is nine times denser than liquid hydrogen.

† For the liquefaction of gases, Herr Linde, of Munich, has constructed an apparatus based upon the same principle as that of Dr. Hampson, and utilizing also the cooling produced solely by the expansion. Two concentric copper tubes, about 50 feet in length, are placed one within the other. The gas, compressed to 220 atmospheres, traverses the first tube, at the extremity of which it expands to 20 atmospheres. Expanded, and consequently cooled, it traverses the second tube in the opposite direction and serves as a refrigerant for the first. The temperature before and after the flow thus lowers gradually until it reaches that of liquefaction. M. d'Arsonval, who presented this apparatus to the Academy of Sciences, at the session of the 20th of June last, points out that with an expenditure of less than 3 horse power it is possible to obtain 60 cubic inches of liquid air an hour. The industrial machines constructed upon the same principle are capable of furnishing as many as 130 pounds of liquid air an hour.

* M. Berthelot, observing that the green line 5566·3 of krypton sensibly coincides with the brilliant line No. 4 (5567) of the aurora borealis, has proposed to give this new gas the name of eosium.

Some time ago Pullman's Palace Car Company built three parlor cars for the Baltimore & Ohio's New York trains, and the radical departure from other cars of this character lay in the toilet room for ladies, which was 8 feet in length. Recently the same company has built eight new sleepers for the New York-St. Louis line of the Baltimore & Ohio, and the designer of the cars has evidently been impelled by the popularity of the ladies' retiring room in the parlor cars to give to the ladies a vast deal more space than they ever had before in sleeping cars. The ladies' retiring room in these cars is exceedingly commodious, and contains, besides other toilet necessities, a dresser with a long pier glass.

CHEMICAL PURIFICATION OF POTABLE WATER.

WATER is justly considered as the agent by means of which most of our contagious diseases are disseminated. No one is ignorant of the fact that cholera, typhoid fever, dysentery, etc., are transmitted especially by impure liquids charged with pathogenic germs. The purification of drinking water is now recommended by all hygienists and physicians. It is a question not only of clarifying it, but also of ridding it of the numerous pathogenic bacilli that contaminate it and render the use of it dangerous. Water, even the purest, may be contaminated after an exposure of a few instants in conduits or reservoirs and even in service pipes. The filtering should therefore be done but a short time before the liquid is used.

A history of filtration would be lengthy, and the models of apparatus used up to the present are numerous. In the first place, charcoal was used as a purify-

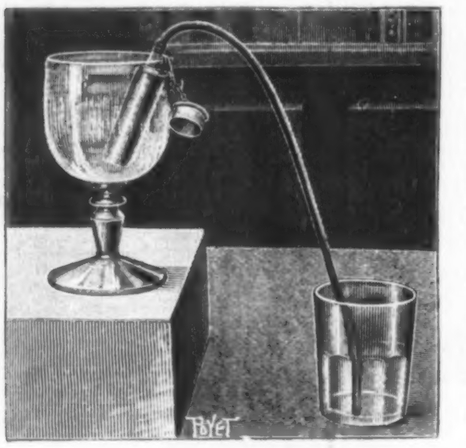


FIG. 1.—THE DELSOL & FILLARD FILTER IN OPERATION.

ing material, and then came filters of charcoal and asbestos, which clarified the water well enough, but had the drawback of allowing too many morbid germs to pass.

Later on a great progress was realized with the Chamberland and Berkefield filters. Finally, quite recently appeared the Eden filter, which obtained for its inventor well merited eulogiums. In this apparatus, the purification and filtration are effected by causing the liquid to pass through powdered charcoal and sheets of paper of a certain consistence.

Aside from these purely physical processes, there are others that are based upon the addition of certain chemical products to water, either for coagulating the mud or for destroying the noxious organisms.

In China and Cochinchina, alum has been used for a long time for precipitating mud and purifying water charged with matter in suspension. Dr. Burlureaux has proposed for the same purpose a powder with a basis of quicklime, bicarbonate of soda, and alum.

Such processes are doubtless efficacious, but they have the inconvenience of requiring the liquid to be left at rest for a certain length of time after the addition of the coagulating agent.

In 1873, Girardin proposed to utilize the antiseptic properties of permanganate of potash. The idea was happy enough, but it did not immediately receive practical sanction.

In 1895, MM. Bordas & Girard presented to the Academy of Sciences an excellent method of chemical purification. The principal substance employed is permanganate of lime, which, in contact with the organic matter of impure water, very rapidly splits up and gives oxygen, oxide of manganese, and lime. As for the permanganate of lime in excess, that is got rid of by filtering the liquid treated through a reducing material formed of an agglomerate of gas, coke, and oxides of manganese. The permanganate is reduced, and is converted into binoxide, and the latter, in the presence of the organic matter of the water or the carbon, passes to the state of lower oxide, capable of fixing anew a portion of the oxygen of the permanganate. Owing to this series of reactions, the agglomerates of carbon and the lower oxides of manganese may operate almost indefinitely.

Prof. Lapeyrere, of the navy, has recently proposed a new method that permits of effecting nearly absolute sterilization. The result of his researches, communicated to the Academy of Medicine on the 27th of December, 1897, form the subject of a very complimentary paper by Dr. Laveran, and have obtained for him the unanimous felicitations of the members of the Academy.

Prof. Lapeyrere's system is based upon the processes of Burlureaux, Bordas & Girard. The water to be purified is treated with a very complex powder containing lime, alum, carbonate of soda, and permanganate of potash in definite proportions.

Alum, a double sulphate of alumina and potassa, in the presence of lime, combines therewith to give a sulphate, which, allied with bicarbonate of soda, forms sulphate of soda and insoluble carbonate of lime. The reducing part designed to retain the permanganate in excess is flannel impregnated with a salt of manganese that produces effects absolutely identical with those obtained with the agglomerates of Bordas & Girard.

Water treated by this method and examined at the laboratory of bacteriology of the School of Rochefort by Dr. Grand-Moursel, surgeon in chief of the navy, contained neither typhic nor choleric bacilli, and, from a practical point of view, could be considered as completely sterilized.

Up to this time the Lapeyrere process had not been applied practically; but since then it has been utilized by MM. Delsol & Fillard in the manufacture of a small pocket filter.

This apparatus, which is very ingenious in construction, is capable of rendering genuine services to the tourist during his excursions. It consists of a tin or aluminum case containing a piece of flannel with a long pile impregnated with the reducing substance. The filter is open at the bottom and provided at the top with a metallic ajutage to which may be fitted a rubber tube 12 or 15 inches in length. Its operation is exceedingly simple. The alumino-calcareous permanganate must be added to the water until the liquid is rose colored—say in the proportion of 4 to 10 grains to the quart. The proportion of powder to be employed varies with the nature of the water and the quantity of foreign matter that it contains. The filtration and the reduction of the permanganate are done through the flannel. To this effect, the body of the filter is immersed in the water that has been treated, and the apparatus is primed by a slight suction through the rubber tube, and the end of the latter, forming a siphon, is placed in the vessel that is to receive the liquid (Fig. 1).

It is necessary to clean the flannel from time to time, either by washing it in ordinary water or water charged with permanganate. After it has been used, the essential part of the filter tends to lose its reducing properties. In order to restore these, it suffices to take out the flannel and treat it for a few minutes with boiling water to which a little hydrochloric acid has been added.

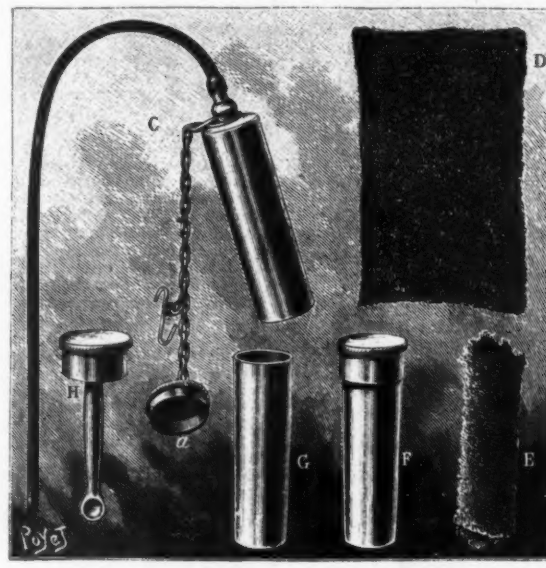


FIG. 3.—THE DIFFERENT PARTS OF THE DELSOL & FILLARD POCKET FILTER.

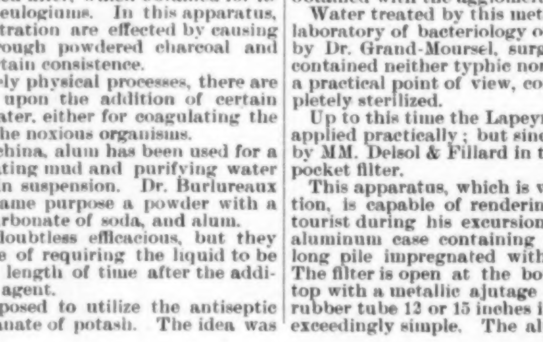


FIG. 2.—THE DELSOL & FILLARD POCKET FILTER.

Figs. 2 and 3 represent the different parts of the filter. All of these are inclosed in a tin box, *A* (Fig. 2), or in a tube that takes up no more space than a cigarette case. The body of the filter, *B*, is provided with a hook and chain to permit of fixing it to the edge of the vessel in which it is to operate. Its bottom is provided with a cap, *a*, to protect the flannel, and which is removed at the moment of filtration, when the apparatus will be arranged as shown at *C*. The flannel is represented spread out at *D* and rolled up for use at *E*. To the apparatus is added a case, *F*, containing a certain quantity of sterilizing powder. A small spoon fixed to the cover of the box, *H*, permits of measuring out the powder more accurately.

MM. Delsol & Fillard propose to extend the Lapeyrere process to household filters. According to them, it would then be possible, without any pressure, to obtain a uniform discharge of 15 gallons an hour. The apparatus would receive a reserve supply of antiseptic powder and would operate regularly without any continuous surveillance.

Several models have been adopted by the manufacturers. One consists of a reservoir at the bottom of which is fixed the reducing chamber connected with the exterior by a cock. The essential piece is protected by a metallic capsule that permits the water to pass only through the lower apertures. The liquid can therefore be collected only in measure as it is filtered. It might nevertheless be advantageous to have a spare supply of it in a special receptacle situated at the lower part of the filter. It is for this reason that in some models there has been combined a vessel, *A* (Fig. 4), provided with a float, *F*, communicating through a rubber tube with the reservoir, *B*. The water becomes stored up in the reservoir at the base and may be drawn off from time to time through the cock, *R*. At one side of the filter there is a discharge plug, *D*, and at the other an air tube bent at its lower part and entering the compartment, *B*. The extremity, *d*, of the tube is always closed by a plug of carded cotton.

These filters, based upon the scientific observations of Prof. Lapeyrere, seem to present all the security desirable from the viewpoint of sterilization and purification of drinking water. Combined in a simple and practical manner, they may be considered as efficient apparatus for which there is a future in store.

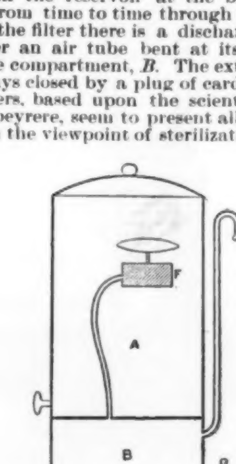


FIG. 4.—KITCHEN FILTER.

For the illustrations and above particulars we are indebted to La Nature.

According to a report issued by the Naval Bureau of Construction, the following degree of progress has been made upon the various war vessels now under construction: The battleship "Illinois" is 55 per cent. completed; the "Kearsarge" is 68 per cent. completed, and her sister vessel, the "Kentucky," is 66 per cent. completed. The Cramps have progressed 63 per cent. with the battleship "Alabama," while the "Wisconsin," building by the Union Iron Works and to be launched in November, is reported to be 48 per cent. completed. The torpedo boats "Rowan" and "Mackenzie" are 99 per cent. completed. The "Goldsborough," in the works of Wolff & Zwicker, is 28 per cent. completed.

[Continued from SUPPLEMENT, No. 1193, page 19132.]

ANTHROPOLOGY.*

AN extensive study of children's games, which had been entered into and pursued by Mrs. Gomme, has been rewarded by the discovery of many facts bearing upon these views. A great number of these games consist of dramatic representations of marriage by capture and marriage by purchase—the idea of exogamy is distinctly embodied in them. You will see a body of children separate themselves into two hostile tribes, establish a boundary line between them, demand the one from the other a selected maiden, and then engage in conflict to determine whether the aggressors can carry her across the boundary or the defenders retain her within it.

There can be little doubt that these games go back to a high antiquity, and there is much probability that they are founded upon customs actually existing or just passing away at the time they were first played. Games of this kind pass down with little change from age to age. Each successive generation of childhood is short; the child who this year is a novice in a game becomes next year a proficient, and the year after an expert, capable of teaching others, and proud of the ability to do so. Even the adult recollects the games of childhood and watches over the purity of the tradition. The child is ever a strong conservative.

Upon the same principle, next to children's games, children's stories claim our attention. Miss Roalfe Cox has collected, abstracted, and tabulated not fewer than 345 variants of Cinderella, Catskin, and Cap o' Rushes. These come from all four quarters of the globe, and some of them are recorded as early as the middle of the sixteenth century. These elaborate stories are still being handed down from generation to generation of children, as they have been for countless generations in the past. Full of detail as they are, they may be reduced to a few primitive ideas. If we view them in their wealth of detail, we shall deem it impossible that they could have been disseminated over the world as they are otherwise than by actual contact of the several peoples with each other. If we view them in their simplicity of idea, we shall be more disposed to think that the mind of man naturally produces the same result in the like circumstances, and that it is not necessary to postulate any communication between the peoples to account for the identity. It does not surprise us that the same complicated physical operations should be performed by far distant peoples without any communication with each other; why should it be more surprising that mental operations, not nearly so complex, should be produced in the same order by different peoples without any such communication? Where communication is proved or provable, it may be accepted as a sufficient explanation; where it is not provable, there is no need that we should assume its existence.

The simple ideas which are traceable in so many places and so far back are largely in relation with that branch of mythology which personifies the operations of nature. Far be it from me to attempt to define the particular phase of it which is embodied in the figure of Cinderella as she sits among the ashes by the hearth or to join in the chase after the solar myth in popular tradition. The form of legend which represents some of the forces of nature under the image of a real or fictitious hero capable of working wonders appears to be widely distributed. Of such, I take it, are the traditions relating to Glooscap, which the late Dr. S. T. Rand collected in the course of his forty years' labors as a missionary among the Micmac Indians of Nova Scotia, where, Mr. Webster says, Glooscap formerly resided. The Indians suppose that he is still in existence, although they do not know exactly where. He looked and lived like other men; ate, drank, smoked, slept and danced along with them; but never died, never was sick, never grew old. Cape Blomidon was his home, the Basin of Minas his beaver-pond. He had everything on a large scale. At Cape Split he cut open the beaver dam, as the Indian name of the cape implies, and to this we owe it that ships can pass there. Spencer's Island was his kettle. His dogs, when he went away, were transformed into two rocks close by. When he returns he will restore them to life. He could do anything and everything. The elements were entirely under his control. You do not often meet with a mischievous exercise of his power. It is a curious part of the tradition, possibly a late addition to it, that it was the encroachments and treachery of the whites which drove him away.

The early inhabitants of the island of Tahiti appear to have had a whole pantheon of gods and heroes representing the various operations of nature. Even the Papuans have a legend in which the morning star is personified acting as a thief. But it is needless to multiply instances. Lord Bacon—who says, "The earliest antiquity lies buried in silence and oblivion. . . . This silence was succeeded by poetical fables, and these at length by the writings we now enjoy; so that the concealed and secret learning of the ancients seems separated from the history and knowledge of the following ages by a veil or partition wall of fables interposing between the things that are lost and those that remain"—has shown in his "Wisdom of the Ancients" that classical mythology was in truth a vast system of nature worship, and in so doing has done more than even he knew, for he has affiliated it to those ideas which have been so commonly formed among rude and primitive peoples. It is true, he says, fables in general are composed of ductile matter, that may be drawn into great variety by a witty talent or an inventive genius, and be delivered of plausible meanings which they never contained. But the argument of most weight with him, he continues, "is that many of these fables by no means appear to have been invented by the persons who relate and divulge them, whether Homer, Hesiod, or others; but whoever attentively considers the thing will find that these fables are delivered down and related by those writers, not as matters then first invented and proposed, but as things received and embraced in earlier ages. The relators drew from the common stock of ancient tradition, and varied but in point of embellishment, which is their own. This principally raises my esteem of these fables, which I receive, not as the product of the age, or invention of the poets, but as sacred relics, gentle whispers, and the breath of better times, that from the traditions of more ancient nations came, at length, into the flutes and trumpets of the Greeks."

Except that he supposes them to be a relic of better times, the poet's dream of a golden age no doubt still ringing in his ears, Bacon had, in this as in many other matters, a clear insight into the meaning of things.

Another idea that appears among very early and primitive peoples, and has had in all time a powerful influence on mankind, is that of a separable spirit. The aborigines of Northwest Central Queensland, who have lately been studied to such excellent purpose by Dr. Walter Roth, the brother of a much esteemed past officer of this section, are in many respects low in the scale of humanity; yet they possess this idea. They believe that the ghost, or shade, or spirit of some one departed can so initiate an individual into the mysteries of the craft of doctor or medicine-man as to enable him, by the use of a death-bone apparatus, to produce sickness and death in another. This apparatus is supposed to extract blood from the victim against whom it is pointed without actual contact, and to insert in him some foreign substance. They will not go alone to the grave of a relative for fear of seeing his ghost. It appears that they have the fancy that Europeans are ghosts. The Tasmanians also, as Mr. Ling-Roth himself tells us, had the same fancy as to the Europeans, and believed that the dead could act upon the living. The Pawnee Indians, we are assured by Mr. Grinnell, believe that the spirits of the dead live after their bodies are dust. They imagine that the little whirlwinds often seen in summer are ghosts. The Blackfeet think the shadow of a person is his soul, and that while the souls of the good are allowed to go to the sand-hills, those of the bad remain as ghosts near the place where they died. The Shillooks of Central Africa are said to believe that the ghostly specters of the dead are always invisibly present with the living, and accompany them wherever they go. The aborigines of Samoa believed in a land of ghosts, to which the spirits of the deceased were carried immediately after death. The religious system of the Amazula, as described by Bishop Callaway, rests largely on the foundation of belief in the continued activity of the disembodied spirits of deceased ancestors.

Mr. Bryce, in his "Impressions of South Africa," says that at Lezapi, in Mashonaland, are three huts, one of which is roofed, and is the grave of a famous chief, whose official name was Makoni. "On the grave there stands a large earthenware pot, which used to be regularly filled with native beer when, once a year, about the anniversary of his death, his sons and other descendants came to venerate and propitiate his ghost. Five years ago, when the white men came into the country, the ceremony was disused, and the poor ghost is now left without honor and nutriment. The pot is broken, and another pot, which stood in an adjoining hut, and was used by the worshipers, has disappeared. The place, however, retains its awesome character, and a native boy who was with us would not enter it. The sight brought vividly to mind the similar spirit worship which went on among the Romans, and which goes on to-day in China; but I could not ascertain for how many generations back an ancestral ghost receives these attentions—a point which has remained obscure in the case of Roman ghosts also."

The aborigines of New Britain are said to believe that the ghosts of their deceased ancestors exercise a paramount influence on human affairs, for good or for evil. They have the poetical idea that the stars are lamps held out by the ghosts to light the path of those who are to follow in their footsteps. On the other hand, they think these ancestral ghosts are most malicious during full moon. Not to multiply instances, we may say, with Mr. Staniland Wake, it is much to be doubted whether there is any race of uncivilized men who are not firm believers in the existence of spirits or ghosts. If this is so, and the idea of a separable spirit, capable of feeling and of action apart from the body, is found to be practically universal among mankind, and to have been excogitated by some of the least advanced among peoples; and if we observe how large a share that idea has in forming the dogmas of the more specialized religions of the present day, we shall not see anything inherently unreasonable in the generalization that the group of theories and practices which constitute the great province of man's emotions and mental operations expressed in the term "religion" has passed through the same stages and produced itself in the same way from these early rude beginnings of the religious sentiment as every other mental exertion. We shall see in religion as real a part of man's organization as any physical member or mental faculty. We shall have no reason to think that it is an exception to any general law of progress and of continuity which is found to prevail in any other part of man's nature.

The same inference may be drawn from many other considerations. Take, for instance, the belief in witchcraft, which is so characteristic of uncivilized man that it is hardly necessary to cite examples of it. The Rev. Mr. Coillard, a distinguished missionary of the Evangelical Society, of Paris, in a delightful record, which has just been published, of his twenty years' labors as a missionary pioneer among the Banyai and Barotzi of the Upper Zambesi, "on the threshold of Central Africa," says: "In the prison of the Barotzi, toiling at earthworks, is a woman—young, bright, and intelligent. She told me her story. A man of remarkably gentle character had married her. The king's sister, Katoka, having got rid of one of her husbands, cast her eyes on this man and took him. He had to forsake his young wife—quite an easy matter. Unfortunately, a little later on, a dead mouse was found in the princess's house. There was a great commotion, and the cry of witchcraft was raised. The bones did not fail to designate the young woman, and she was made a convict. A few years ago she would have been burnt alive. Ah, my friends, paganism is an odious and a cruel thing!" Ah, Mr. Coillard, is it many years ago that she would have been burnt alive or drowned in Christian England or Christian America? Surely the odiousness and the cruelty are not special to paganism any more than to Christianity. The one and the other are due to ignorance and superstition, and these are more hateful in a Matthew Hale or a Patrick Henry than in a Barotzi princess in the proportion that they ought to have been more enlightened and intelligent than she. It is only 122 years since John Wesley wrote: "I cannot give up to all the Deists in Great Britain the existence of witchcraft;" and I believe that to this day the Order of Exorcists is a recognized order in the Catholic Church.

The same line of argument—which, of course, I am only indicating here—might be pursued, I am persuaded, in numberless other directions. Mr. Frazer, in his work on the Golden Bough, has most learnedly applied it to a remarkable group of beliefs and observances. Mr. Hartland has followed up that research with a singularly luminous study of several other groups of ideas in the three volumes of his "Legend of Perseus." More recently, Mr. Andrew Lang has sought to show that the idea of a Supreme Being occurs at an earlier stage in the development of savage thought than we had hitherto supposed. Striking as these various collocations of facts and the conclusions drawn from them may appear, I am convinced there is much more for the folklorist to do in the same directions.

The principle that underlies it all seems to be this: man can destroy nothing, man can create nothing, man cannot of his own mere volition even permanently modify anything. A higher power restrains his operations, and often reverses his work. You think you have exterminated a race: you have put to the sword every male you can find, and you have starved and poisoned all the survivors of the community. In the meanwhile, their blood has been mingled with yours, and for generations to come your bones and those of your descendants will preserve a record of that lost race. You think you have exterminated a religion; you have burned to death all of its teachers you can find, and converted forcibly or by persuasion the rest of the community. But you cannot control men's thoughts, and the old beliefs and habits will spring up again and again, and insensibly modify your own religion, pure as you may suppose it to be.

Huxley, in his address to the department of anthropology twenty years ago, said, with the force and candor that were characteristic of him: "Anthropology has nothing to do with the truth or falsehood of religion—it holds itself absolutely and entirely aloof from such questions; but the natural history of religion, and the origin and the growth of the religions entertained by the different kinds of the human race, are within its proper and legitimate province." I do not presume to question that as an absolutely accurate definition of the position—it could not be otherwise; but if there be any here to whom what I have been suggesting is in any sense novel or startling, I should be glad to be allowed to say one word of reassurance to them. When my friend Mr. Clodd shocked some of the members of the Folklore Society by his frank statement of conclusions at which he had arrived, following the paths I have indicated, it was said we must fall back on the evidences of Christianity. What more cogent evidence of Christianity can you have than its existence? It stands to-day as the religion which, in most civilized countries, represents that which has been found by the operation of natural laws to be best suited for the present circumstances of mankind. You are a Christian because you cannot help it. Turn Mahometan to-morrow—will you stop the spread of Christianity? Your individual renunciation of Christianity will be but a ripple on a wave. Civilized mankind holds to Christianity, and cannot but do so till it can find something better. This, it seems to me, is a stronger evidence of Christianity than any of the loose-jointed arguments I find in evidential literature.

Upon this thorny subject I will say no more. I would not have said so much, but that I wish to show that these considerations are not inconsistent with the respect I entertain, and desire now as always to express, for those feelings and sentiments which are esteemed to be precious by the great majority of mankind, which solace them under the adversities of life and nerve them for the approach of death, and which stimulate them to works of self-sacrifice and of charity that have conferred untold blessings on humanity. I reverence the divine founder of Christianity all the more when I think of him as one who so well "knew what was in man" as to build upon ideas and yearnings that had grown in man's mind from the earliest infancy of the race.

To return. If continuity be the key that unlocks the receptacle where lie the secrets of man's history—physical, industrial, mental, and moral; if in each of these respects the like processes are going on—it follows, as I have already said, that the only satisfactory study of man is a study of the whole man. It is for this reason that I ask you to take especial interest in the proceedings of one of the committees of this section, which has adopted such a comprehensive study as the guiding principle of its work—I mean the Ethnographical Survey Committee. I have so often addressed this section and the conference of corresponding societies on the matter, since the committee was first appointed at the Edinburgh meeting, on the suggestion of my friend Prof. Haddon, that I can hardly now refer to it without repeating what has been already said or forestalling what will be said when its report is presented to you, but its programme so fully realizes that which has been in my mind in all that I have endeavored to say that I must make one more effort to enlist your active interest in its work.

The scheme of the committee includes the simultaneous recording in various districts of the physical characters, by measurement and by photography, the current traditions and beliefs, the peculiarities of dialect, the monuments and other remains of ancient culture, and the external history of the people. The places in the United Kingdom where this can be done with advantage are such only as have remained unaffected by the great movements of population that have occurred, especially of late years. It might have been thought that such places would be very few; but the preliminary inquiries of the committee resulted in the formation of a list of between 300 and 400. So far, therefore, as the testimony of the very competent persons whose advice was sought by them is to be relied on, it is evident that there is ample scope for their work. At the same time, the process of migration from country to town is going on so rapidly that every year diminishes the number of such places. One thinks with regret how much easier the work would have been one or two or three generations ago; but that consideration should only induce us to put it off no longer.

The work done by the lamented Dr. Walter Gregor

* Opening address by E. W. Brabrook, C.B., F.S.A., president of the section, at the meeting of the British Association.

for this committee in Dumfriesshire and other parts of Scotland is an excellent type of the way in which such work should be done. His collections of physical measurements and of folklore have been published in the fourth and fifth reports of the committee. There can be no doubt that few men possess the faculty he had of drawing forth the confidence of the villagers and getting them to tell him their superstitions and their old customs. He succeeded in recording from their lips not fewer than 733 items of folklore. They not merely form exceedingly pleasant reading, such as is, perhaps, not often met with in a British Association report, but they also will be found to throw considerable light on the views which I have ventured to lay before you. It is much to be wished that others who have the like faculty, if even in a lesser degree, could be induced to take up similar work in other districts, now that Dr. Gregor has so well shown the way in which it ought to be done.

The work done by the committee for the Ethnographical Survey of Canada, the completion of the Ethnographical Survey of the Northwestern tribes which has been ably conducted for many years, and the progress made in the Ethnographical Survey of India, will also be brought under your notice, the latter in a paper by Mr. Crooke, who has worked with Mr. Risley upon it.

Another movement, which was originated by this section at the Liverpool meeting, and was referred to in the report of the Council of the Association last year, has made some progress since that report was presented. Upon the recommendation of this section, the general committee passed the following resolution and referred it to the council for consideration and action:

"That it is of urgent importance to press upon the government the necessity of establishing a Bureau of Ethnology for Greater Britain, which, by collecting information with regard to the native races within and on the borders of the empire, will prove of immense value to science and to the government itself."

The council appointed a committee, consisting of the president and general officers, with Sir John Evans, Sir John Lubbock, Prof. Tylor, and your esteemed vice president, Mr. Read, the mover of the resolution. Their report is printed at length in last year's report of council, and shows clearly how useful and how easily practicable the establishment of such a bureau would be. The council resolved that the trustees of the British Museum be requested to consider whether they could allow the proposed bureau to be established in connection with the Museum. I understand that those trustees have returned a favorable answer; and I cannot doubt that the joint representations which they and this Association will make to Her Majesty's government will result in the adoption of a scheme calculated to realize all the advantages which we in this section have so long looked for from it. In the Secretary of State for the Colonies and the Chancellor of the Exchequer we have statesmen who cannot fail to appreciate the benefits the community must derive from acquiring accurate and scientific knowledge of the multifarious races which compose the empire.

Those of us who visited the United States last year had the opportunity of observing the excellent work which is done by the Bureau of Ethnology at Washington, and those who stayed at home are probably familiar with the valuable publications of that department. An act of Congress twenty years ago appropriated £4,000 a year to the Smithsonian Institution for the continuance of researches in North American anthropology. The control of the bureau was entrusted to the able hands of Major Powell, who gathered round him a band of skilled workers, many of whom had been previously engaged on ethnographic research under the direction of the Geographical and Geological Survey of the Rocky Mountain region. In field work and in office work, to use Major Powell's convenient distinction, ample return has ever since been rendered to the United States government for the money thus appropriated, which has since been increased to £8,000 a year. Our own Bureau of Ethnology would have a wider sphere of operations and be concerned with a greater number of races. It would tend to remove from us the reproach that has in too many cases not been without foundation—that we have been content to govern races by the strong hand without caring to understand them, and have thus been the cause of injustice and oppression from ignorance rather than from malevolence. If that were only a record of the past, we might be content with mere unavailing regret; but the colonial empire is still expanding, and we and our competitors in that field are still absorbing new districts—a practice which will probably continue as long as any spot of ground remains on the face of the globe occupied by an uncivilized race.

Would it not be worth while at this juncture to extend to the peoples of Africa, for instance, the principles and methods of the Ethnographic Survey—to study thoroughly all their physical characters, and at the same time to get an insight into the working of their minds, the sentiments and ideas that affect them most closely, their convictions of right and wrong, their systems of law, the traditions of the past that they cherish, and the rude accomplishments they possess? If for such a service investigators like Dr. Roth, who began his researches in Queensland by so close a study of the languages and dialects of the people that he thoroughly won their confidence, could be found, the public would soon learn the practical value of anthropological research. If the considerations which I have endeavored to urge upon you should lead not only the scientific student but the community at large to look upon that which is strange in the habits and ways of thinking of uncivilized peoples as representing with more or less accuracy a stage in that long continuity of mental progress without which civilized peoples would not be what and where they are, it could not but favorably affect the principles and practice of colonization. Tout comprendre c'est tout pardonner. The more intimate our acquaintance with the races we have to deal with and to subjugate, the more we shall find what it means to stand with them on the same platform of common humanity. If the object of government be, as it ought to be the good of the governed, it is for the governing race to fit itself for the task by laying to heart the lessons and adopting the processes of practical anthropology.

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